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TECHNICAL REPORT D-78-37

HANDBOOK FOR TERRESTRIAL WILDLIFE HABITAT DEVELOPMENT ON DREDGED MATERIAL

58 Coastal Zone Resources Division
Ocean Data Systems, Inc.
Wilmington, N. C. 28403

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Summary Environmental Laboratory
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15 August 1978

SUBJECT: Transmittal of Technical Report D-78-37

TO: All Report Recipients

1. The technical report transmitted herewith represents the results of one of a series of research efforts (work units) conducted as part of Task 4B (Terrestrial Habitat Development) of the Corps of Engineers' Dredged Material Research Program (DMRP). Task 4B was part of the Habitat Development Project (HDP) and had as its objective the development and application of habitat management methodologies on upland disposal areas for purposes of planned habitat creation, reclamation, and mitigation.
2. This report, "Handbook for Terrestrial Wildlife Habitat Development on Dredged Material" (Work Unit 4B08), identifies 250 useful wildlife food and cover species that could be established on dredged material. Management aspects of 100 of the most promising species are discussed in detail.
3. Upland habitat development on dredged material has been successfully demonstrated at three HDP field sites: Nott Island, in the Connecticut River, Connecticut (4B04); Bolivar Peninsula, in Galveston Bay, Texas (4A13); and Miller Sands, in the Columbia River, Oregon (4B05). Other work units of the DMRP directly relevant to terrestrial habitat development relate to upland succession (5B03) and island habitat development (Task 4F).
4. Evaluated together, the terrestrial habitat field demonstrations and related succession and insular studies establish and define the conditions under which habitat development is feasible. Data presented in these research reports will be synthesized in the technical reports entitled "Upland and Wetland Habitat Development with Dredged Material: Ecological Considerations" (2A08); and "Upland Habitat Development with Dredged Material: Engineering and Plant Propagation" (4B09).

JOHN L. CANNON
Colonel, Corps of Engineers
Commander and Director

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20. ABSTRACT (Continued).

discussion of habitat, soil requirements, establishment and maintenance, disease and insect problems, and wildlife value. A range map and illustration are given along with appropriate miscellaneous comments. The handbook also outlines a suggested approach for developing terrestrial wildlife habitat on dredged material; discusses wildlife species inhabiting dredged material areas; and recommends techniques for propagation, establishment, and maintenance of plantings.

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PREFACE

The investigation described in this report was performed under Contract No. DACW39-77-C-0077, dated 29 September 1977, between the U. S. Army Engineer Waterways Experiment Station (WES), Vicksburg, Mississippi, and Coastal Zone Resources Division (CZR), Ocean Data Systems, Inc. (ODSI), Wilmington, North Carolina. The study was sponsored by the Office, Chief of Engineers, U. S. Army.

The study, conducted from October 1977 to February 1978, was under the general supervision of James M. Hudgens, Vice-President of ODSI and General Manager of CZR. Bruce W. Bolick, Wildlife Biologist, was Project Manager, and Julie H. Moore, Botanist, was Assistant Project Manager. Other principal CZR participants were Sarah S. Robinson, Wildlife Biologist, and Steven W. Leonard, Botanist. Dr. Thomas L. Quay, Terrestrial Vertebrate Ecologist-Ornithologist and Professor of Zoology at North Carolina State University, and Karl E. Graetz, Plant Materials Specialist (Soil Conservation Service, retired), were associate CZR consultants. Dr. James F. Parnell, Professor of Biology, University of North Carolina, Wilmington, served as a technical consultant, especially in reference to colonial nesting birds and other nongame animals. Graphics (range maps and illustrations) were prepared by Lucy R. Smith and David R. Peterson.

The contract was managed by Harvey L. Jones and L. Jean Hunt of the Dredged Material Research Program (DMRP), Environmental Laboratory (EL), WES. Mary C. Landin and Dr. Robert F. Soots of WES offered constructive comments and suggestions. Reviews were conducted by Dr. John Crawford, Oregon State University; Mr. Joe Hardy, U. S. Fish and Wildlife Service, Vicksburg, Miss.; Mr. Charles Newling, New England Division, CE; Mr. Paul Peloquin, Walla Walla District, CE; Dr. Nova Silvy, Texas A & M University; and Dr. Gary Tucker, WES. The study was under the general supervision of Dr. Hanley K. Smith, Project Manager, Habitat Development Project, and Dr. John Harrison, Chief, EL.

The Director of WES during the study and preparation of this report was COL John L. Cannon, CE. Technical Director was Mr. F. R. Brown.

TABLE OF CONTENTS

	<u>Page</u>
PREFACE	2
LIST OF TABLES.	8
LIST OF FIGURES	8
CONVERSION FACTORS, U. S. CUSTOMARY TO METRIC (SI).	12
PART I: BACKGROUND AND OBJECTIVES.	13
PART II: METHODOLOGY	15
PART III: SUGGESTED APPROACH TO TERRESTRIAL WILDLIFE HABITAT DEVELOPMENT ON DREDGED MATERIAL.	19
Evaluation of the Site	21
Sediment Characteristics.	21
Topography and Configuration.	21
Compatible Land Use	22
Size and Location	22
Plants and Animals on or Adjacent to the Site	23
Flooding.	23
Future Dredged Material Deposition.	23
Determination of Wildlife Habitat Development Goal(s).	24
Selection of Plant Species	27
Preparation of Site.	29
Deposition of Sediments.	29
Preparation of Substrate	30
Establishment and Maintenance of Vegetation.	30
PART IV: WILDLIFE IN TERRESTRIAL HABITATS ON DREDGED MATERIAL. . .	31
Game Animals and Furbearers.	35
Small Game and Furbearing Mammals	35
Large Game Mammals.	37
Game Birds.	38
Migratory Game Birds	38
Nonmigratory Game Birds	40
Nongame Animals.	41
Shorebirds, Wading Birds, and Water Birds	41
Small Land Birds.	47
Hawks and Owls.	48
Small Mammals	48
Amphibians and Reptiles	48
Threatened and Endangered Species	50

TABLE OF CONTENTS (Continued)

	<u>Page</u>
PART V: PROPAGATION, ESTABLISHMENT, AND MAINTENANCE PRACTICES. . .	52
Plant Selection.	52
Seed Treatment	53
Collection.	53
Scarification	53
Stratification.	54
Propagation by Cuttings.	55
Field Planting	56
Dates	56
Fertilization	56
Methods	58
Maintenance	63
PART VI: SYNOPSES OF PLANT SPECIES OF VALUE FOR TERRESTRIAL WILDLIFE HABITAT DEVELOPMENT ON DREDGED MATERIAL.	65
Trees.	78
<i>Celtis laevigata</i> , sugar hackberry	78
<i>Juniperus virginiana</i> , eastern redcedar.	81
<i>Pinus contorta</i> , shore pine.	85
<i>Pinus taeda</i> , loblolly pine.	87
<i>Prunus serotina</i> , black cherry	91
<i>Quercus virginiana</i> , live oak.	94
Shrubs	97
<i>Amelanchier canadensis</i> , Canadian serviceberry	97
<i>Atriplex canescens</i> , wingscale	100
<i>Callicarpa americana</i> , beautyberry	103
<i>Cornus stolonifera</i> , redstem dogwood	106
<i>Elaeagnus angustifolia</i> , Russian olive	109
<i>Elaeagnus pungens</i> , thorny elaeagnus	111
<i>Elaeagnus umbellata</i> , autumn olive	114
<i>Ilex verticillata</i> , winterberry.	117
<i>Ilex vomitoria</i> , yaupon.	120
<i>Lespedeza bicolor</i> , bicolor lespedeza.	123
<i>Myrica californica</i> , Pacific wax myrtle.	126
<i>Myrica cerifera</i> , wax myrtle	128
<i>Myrica pensylvanica</i> , bayberry	130
<i>Prosopis juliflora</i> , honey mesquite.	134
<i>Prunus virginiana</i> , common chokecherry	137
<i>Rhamnus purshiana</i> , cascara buckthorn.	140
<i>Rhus copallina</i> , dwarf sumac	143
<i>Rhus glabra</i> , smooth sumac	145
<i>Rosa carolina</i> , Carolina rose.	148

TABLE OF CONTENTS (Continued)

	<u>Page</u>
<i>Rosa multiflora</i> , multiflora rose.	150
<i>Rubus allegheniensis</i> , Allegheny blackberry.	154
<i>Rubus argutus</i> , sharp-toothed blackberry	156
<i>Rubus cuneifolius</i> , sand blackberry.	158
<i>Rubus spectabilis</i> , salmonberry.	160
<i>Salix hookeriana</i> , Hooker's willow	163
<i>Salix interior</i> , sandbar willow.	165
<i>Sambucus caerulea</i> , blue elderberry.	168
<i>Sambucus canadensis</i> , American elderberry.	170
<i>Vaccinium corymbosum</i> , highbush blueberry.	173
<i>Vaccinium ovatum</i> , western huckleberry	175
Vines.	178
<i>Lonicera japonica</i> , Japanese honeysuckle	178
<i>Parthenocissus quinquefolia</i> , Virginia creeper	181
<i>Smilax auriculata</i> , wild bamboo.	184
<i>Smilax bona-nox</i> , fringed catbrier	186
<i>Smilax glauca</i> , sawbrier	188
<i>Smilax rotundifolia</i> , common greenbrier.	190
<i>Vitis aestivalis</i> , summer grape.	192
<i>Vitis riparia</i> , riverbank grape.	194
<i>Vitis rotundifolia</i> , muscadine grape	196
<i>Vitis vulpina</i> , frost grape.	198
Herbs.	201
<i>Amaranthus retroflexus</i> , redroot pigweed	201
<i>Ambrosia artemisiifolia</i> , common ragweed	204
<i>Ambrosia psilostachya</i> , western ragweed.	206
<i>Chenopodium album</i> , common lambsquarters	209
<i>Croton capitatus</i> , woolly croton	212
<i>Croton glaucolosus</i> var. <i>septentrionalis</i> , tropic croton	214
<i>Cyperus esculentus</i> , chufa	217
<i>Erodium cicutarium</i> , common filaree.	220
<i>Glycine ussuriensis</i> , reseeding soybean.	222
<i>Helianthus maximiliani</i> , Maximilian's sunflower.	225
<i>Lathyrus palustris</i> , marsh pea	227
<i>Lathyrus sylvestris</i> , flat pea	229
<i>Lespedeza cuneata</i> , sericea lespedeza.	231
<i>Medicago lupulina</i> , black medick	234
<i>Phytolacca americana</i> , pokeberry	237
<i>Polygonum convolvulus</i> , wild buckwheat	240
<i>Polygonum pennsylvanicum</i> , Pennsylvania smartweed	242
<i>Rumex acetosella</i> , sheepsorrel	245
<i>Sesbania exaltata</i> , hemp sesbania.	248
<i>Strophostyles helvola</i> , trailing wild bean	251
<i>Trifolium pratense</i> , red clover.	254
<i>Trifolium repens</i> , white clover.	256

TABLE OF CONTENTS (Continued)

	<u>Page</u>
Grasses.	259
<i>Ammophila arenaria</i> , European beachgrass	259
<i>Ammophila breviligulata</i> , American beachgrass.	261
<i>Avena sativa</i> , oats.	264
<i>Digitaria ischaemum</i> , smooth crabgrass	267
<i>Digitaria sanguinalis</i> , large crabgrass.	269
<i>Echinochloa crusgalli</i> , barnyard grass	272
<i>Echinochloa crusgalli</i> var. <i>frumentacea</i> , Japanese millet.	274
<i>Echinochloa walteri</i> , Walter's millet.	276
<i>Festuca arundinacea</i> , tall fescue.	279
<i>Festuca rubra</i> , red fescue	281
<i>Hordeum vulgare</i> , barley	284
<i>Lolium multiflorum</i> , Italian ryegrass.	287
<i>Panicum amarulum</i> , shoredune panicum	289
<i>Panicum clandestinum</i> , deertongue.	291
<i>Panicum dichotomiflorum</i> , fall panicum	293
<i>Panicum miliaceum</i> , proso millet	296
<i>Panicum ramosum</i> , browntop millet.	298
<i>Panicum texanum</i> , Texas millet	300
<i>Panicum virgatum</i> , switchgrass	300
<i>Paspalum boscianum</i> , bull paspalum	304
<i>Paspalum notatum</i> , Bahia grass	306
<i>Paspalum vaginatum</i> , seashore paspalum	308
<i>Pennisetum glaucum</i> , pearl millet.	311
<i>Phalaris arundinacea</i> , reed canary grass	314
<i>Secale cereale</i> , rye	317
<i>Setaria italica</i> , foxtail millet	320
<i>Setaria lutescens</i> , yellow bristlegrass.	322
<i>Setaria viridis</i> , green bristlegrass	324
<i>Sorghum vulgare</i> , sorghum (milo)	326
<i>Spartina patens</i> , saltmeadow cordgrass	329
<i>Triticum aestivum</i> , wheat.	332
<i>Zea mays</i> , corn.	335
LIST OF CREDITS	339
LITERATURE CITED.	340
BIBLIOGRAPHY.	354
Plants	354
Birds.	360
Mammals.	365
Miscellaneous.	368

TABLE OF CONTENTS (Concluded)

	<u>Page</u>
APPENDIX A: 250 PLANTS WITH FOOD OR COVER VALUE FOR WILDLIFE LISTED BY STATE AND LIFE FORM.	A1
APPENDIX B: RARE, ENDANGERED, OR THREATENED SPECIES REFERENCES . .	B1
APPENDIX C: ADDRESSES FOR SOIL CONSERVATION SERVICE PLANT MATERIALS SPECIALISTS, PLANT MATERIALS CENTERS, AND REGIONAL BIOLOGISTS.	C1

LIST OF TABLES

<u>Number</u>		<u>Page</u>
1.	Distribution by State of 100 Plants for Terrestrial Wildlife Habitat Development on Dredged Material. . . .	69
2.	Soil Conditions Tolerated by the 100 Plants Selected for Terrestrial Wildlife Habitat.	73

LIST OF FIGURES

1.	Pine seeds stratified in damp sphagnum moss	54
2.	Saltmeadow cordgrass established in rows by planting a mixture of seeds and fertilizer with a single-row fertilizer distributor.	57
3.	American beachgrass seedlings being planted with a tractor-drawn mechanical planter.	59
4.	American beachgrass planting stock and the "sharpshooter" spade.	59
5.	Grass planted in rows on dredged material	60
6.	A protective cover of rye established on dredged material in the fall prior to a spring planting of a more permanent species.	61
7.	A test plot of eastern redcedar established in a protective 2-year-old stand of American beachgrass. . .	62
8.	Established 3-year-old stand of American beachgrass with a protective and stabilizing sand fence.	63
9.	A. Wild bamboo seedlings emerging on dune sand B. Live oak seedlings emerging in the spring from acorns planted the previous fall.	64 64
10.	<i>Celtis laevigata</i> , sugar hackberry	79
11.	<i>Juniperus virginiana</i> , eastern redcedar.	82
12.	<i>Pinus contorta</i> , shore pine.	86
13.	<i>Pinus taeda</i> , loblolly pine.	88
14.	<i>Prunus serotina</i> , black cherry	92
15.	<i>Quercus virginiana</i> , live oak.	95
16.	<i>Amelanchier canadensis</i> , Canadian serviceberry	98
17.	<i>Atriplex canescens</i> , wingscale	101
18.	<i>Callicarpa americana</i> , beautyberry	104

LIST OF FIGURES (Continued)

<u>Number</u>		<u>Page</u>
19.	<i>Cornus stolonifera</i> , redstem dogwood	107
20.	<i>Elaeagnus angustifolia</i> , Russian olive	110
21.	<i>Elaeagnus pungens</i> , thorny elaeagnus	112
22.	<i>Elaeagnus umbellata</i> , autumn olive	115
23.	<i>Ilex verticillata</i> , winterberry.	118
24.	<i>Ilex vomitoria</i> , yaupon.	121
25.	<i>Lespedeza bicolor</i> , bicolor lespedeza.	124
26.	<i>Myrica californica</i> , Pacific wax myrtle.	127
27.	<i>Myrica cerifera</i> , wax myrtle	129
28.	<i>Myrica pensylvanica</i> , bayberry	131
29.	<i>Prosopis juliflora</i> , honey mesquite.	135
30.	<i>Prunus virginiana</i> , common chokecherry	138
31.	<i>Rhamnus purshiana</i> , cascara buckthorn.	141
32.	<i>Rhus copallina</i> , dwarf sumac	144
33.	<i>Rhus glabra</i> , smooth sumac	146
34.	<i>Rosa carolina</i> , Carolina rose.	149
35.	<i>Rosa multiflora</i> , multiflora rose.	151
36.	<i>Rubus allegheniensis</i> , Allegheny blackberry.	155
37.	<i>Rubus argutus</i> , sharp-toothed blackberry	157
38.	<i>Rubus cuneifolius</i> , sand blackberry.	159
39.	<i>Rubus spectabilis</i> , salmonberry.	161
40.	<i>Salix hookeriana</i> , Hooker's willow	164
41.	<i>Salix interior</i> , sandbar willow.	166
42.	<i>Sambucus caerulea</i> , blue elderberry.	169
43.	<i>Sambucus canadensis</i> , American elderberry.	171
44.	<i>Vaccinium corymbosum</i> , highbush blueberry.	174
45.	<i>Vaccinium ovatum</i> , western huckleberry	176
46.	<i>Lonicera japonica</i> , Japanese honeysuckle	179
47.	<i>Parthenocissus quinquefolia</i> , Virginia creeper	182
48.	<i>Smilax auriculata</i> , wild bamboo.	185
49.	<i>Smilax bona-nox</i> , fringed catbrier	187

LIST OF FIGURES (Continued)

<u>Number</u>		<u>Page</u>
50.	<i>Smilax glauca</i> , sawbrier	189
51.	<i>Smilax rotundifolia</i> , common greenbrier.	191
52.	<i>Vitis aestivalis</i> , summer grape.	193
53.	<i>Vitis riparia</i> , riverbank grape.	195
54.	<i>Vitis rotundifolia</i> , muscadine grape	197
55.	<i>Vitis vulpina</i> , frost grape.	199
56.	<i>Amaranthus retroflexus</i> , redroot pigweed	202
57.	<i>Ambrosia artemisiifolia</i> , common ragweed	205
58.	<i>Ambrosia psilostachya</i> , western ragweed.	207
59.	<i>Chenopodium album</i> , common lambsquarters	210
60.	<i>Croton capitatus</i> , woolly croton	213
61.	<i>Croton glandulosus</i> , tropic croton	215
62.	<i>Cyperus esculentus</i> , chufa	218
63.	<i>Erodium cicutarium</i> , common filaree.	221
64.	<i>Glycine ussuriensis</i> , reseeding soybean.	223
65.	<i>Helianthus maximiliani</i> , Maximilian's sunflower.	226
66.	<i>Lathyrus palustris</i> , marsh pea	228
67.	<i>Lathyrus sylvestris</i> , flat pea	230
68.	<i>Lespedeza cuneata</i> , sericea lespedeza.	232
69.	<i>Medicago lupulina</i> , black medick	235
70.	<i>Phytolacca americana</i> , pokeberry	238
71.	<i>Polygonum convolvulus</i> , wild buckwheat	241
72.	<i>Polygonum pensylvanicum</i> , Pennsylvania smartweed	243
73.	<i>Rumex acetosella</i> , sheepsorrel	246
74.	<i>Sesbania exaltata</i> , hemp sesbania.	249
75.	<i>Strophostyles helvola</i> , trailing wild bean	252
76.	<i>Trifolium pratense</i> , red clover.	255
77.	<i>Trifolium repens</i> , white clover.	257
78.	<i>Ammophila arenaria</i> , European beachgrass	260
79.	<i>Ammophila breviligulata</i> , American beachgrass.	262
80.	<i>Avena sativa</i> , oats.	265

LIST OF FIGURES (Concluded)

<u>Number</u>		<u>Page</u>
81.	<i>Digitaria ischaemum</i> , smooth crabgrass	268
82.	<i>Digitaria sanguinalis</i> , large crabgrass.	270
83.	<i>Echinochloa crusgalli</i> , barnyard grass	273
84.	<i>Echinochloa crusgalli</i> var. <i>frumentacea</i> , Japanese millet.	275
85.	<i>Echinochloa walteri</i> , Walter's millet.	277
86.	<i>Festuca arundinacea</i> , tall fescue.	280
87.	<i>Festuca rubra</i> , red fescue	282
88.	<i>Hordeum vulgare</i> , barley	285
89.	<i>Lolium multiflorum</i> , Italian ryegrass.	288
90.	<i>Panicum amarulum</i> , shoredune panicum	290
91.	<i>Panicum clandestinum</i> , deertongue.	292
92.	<i>Panicum dichotomiflorum</i> , fall panicum	294
93.	<i>Panicum miliaceum</i> , proso millet.	297
94.	<i>Panicum ramosum</i> , browntop millet	299
95.	<i>Panicum texanum</i> , Texas millet.	301
96.	<i>Panicum virgatum</i> , switchgrass.	302
97.	<i>Paspalum boscianum</i> , bull paspalum.	305
98.	<i>Paspalum notatum</i> , Bahia grass.	307
99.	<i>Paspalum vaginatum</i> , seashore paspalum	309
100.	<i>Pennisetum glaucum</i> , pearl millet.	312
101.	<i>Phalaris arundinacea</i> , reed canary grass	315
102.	<i>Secale cereale</i> , rye	318
103.	<i>Setaria italica</i> , foxtail millet	321
104.	<i>Setaria lutescens</i> , yellow bristlegrass.	323
105.	<i>Setaria viridis</i> , green bristlegrass	325
106.	<i>Sorghum vulgare</i> , sorghum (milo)	327
107.	<i>Spartina patens</i> , saltmeadow cordgrass	330
108.	<i>Triticum aestivum</i> , wheat.	333
109.	<i>Zea mays</i> , corn.	336

Conversion Factors, U. S. Customary to Metric (SI)

Units of measurement used in this report can be converted as follows:

<u>Multiply</u>	<u>By</u>	<u>To Obtain</u>
<u>U. S. Customary to Metric (SI)</u>		
inches	2.540	centimetres
feet	0.305	metres
square feet	0.093	square metres
yards	0.914	metres
acres	4046.856	square metres
acres	0.405	hectares
ounces	0.028	kilograms
pounds (mass)	0.454	kilograms
tons	0.907	metric tons
bushels	35.238	litres
gallons	3.785	litres
tablespoons	14.784	millilitres
teaspoons	4.916	millilitres
Fahrenheit degrees	5/9	Celsius degrees or Kelvins *

*To obtain Celsius (C) temperature readings from Fahrenheit (F) readings, use the following formula: $C = (5/9)(F - 32)$. To obtain Kelvin (K) readings, use: $K = (5/9)(F - 32) + 273.15$.

HANDBOOK FOR TERRESTRIAL WILDLIFE HABITAT
DEVELOPMENT ON DREDGED MATERIAL

PART I: BACKGROUND AND OBJECTIVES

1. The need to maintain safe and efficient port facilities, to deepen channels and basins to keep the ports competitive, and to extend the waterways vital to American commerce, defense, recreation, and other interests, requires the dredging of large volumes of materials. The United States Army Corps of Engineers (Corps), as part of its mission, conducts dredging activities nationwide. The surge of public concern for the quality of the human environment has caused many once-routine dredging practices to be questioned, and widespread public interest has given impetus to inquiries by the Corps, the U. S. Fish and Wildlife Service (USFWS), universities, and state conservation agencies into the effects of dredging.

2. Acting under Congressional authority granted in the River and Harbor Act of 1970, the Office, Chief of Engineers (OCE) assigned the U. S. Army Engineer Waterways Experiment Station (WES) the lead role in planning and conducting a program of study, research, and experimentation relating to dredged material. The Office of Dredged Material Research, later given status in the Environmental Effects Laboratory (EEL) as the Dredged Material Research Program (DMRP), prepared a research design charting an orderly sequence of activities to meet the objectives specified by the Congress and OCE. The goals of the DMRP were to provide definitive information on the environmental impacts of dredging and dredged material disposal operations and to develop technically satisfactory, environmentally compatible, and economically feasible dredging and disposal alternatives, including consideration of dredged material as a manageable resource. The DMRP activities were organized under several projects, one of which was the Habitat Development Project (HDP), an interdisciplinary research effort aimed at determining the feasibility of developing biologically productive

habitats on dredged material. The goals of the HDP were to (1) determine what mechanisms exist that cause the success or failure of habitat development, (2) determine the environmental effects of dredged material disposal and habitat development, and (3) develop feasible alternatives for disposal of dredged material to improve the biological characteristics of the disposal site.

3. To further the goals of the HDP, WES contracted Coastal Zone Resources Division (CZR) of Ocean Data Systems, Inc. (ODSI), to conduct a study of terrestrial wildlife habitat development on dredged material. The specific scope of work was designed to produce a guide for the selection of plants which can be used for the development of terrestrial wildlife habitat on dredged material within the contiguous United States. However, the broader WES objective of the work was to provide this information in the form of a user-oriented handbook for use by the Corps and other agencies for planning, evaluation, and review of terrestrial wildlife habitat development at dredged material disposal sites.

PART II: METHODOLOGY

4. To conduct the habitat development study and to prepare the handbook, CZR assembled a study team consisting of two wildlife biologists (one with botanical experience and both with technical writing and editing experience), two botanists, an ornithologist-vertebrate ecologist, and a former U. S. Department of Agriculture (USDA) Soil Conservation Service (SCS) Plant Materials Specialist. The study team produced the handbook by (1) drawing upon personal knowledge and experience, (2) interviewing personnel within various state and federal agencies, and (3) referring to a wide variety of literature sources identified and/or obtained from the personal files of study team members, from the CZR library, from contacts with state and federal agencies, from various university libraries, and from computer literature searches.

5. CZR contacted state wildlife department personnel in various states, USFWS personnel, and USDA-SCS plant materials specialists.

6. At CZR's request, computer literature searches were conducted by (1) the Fish and Wildlife Reference Service (Denver Public Library), (2) the National Technical Information Service, (3) the National Agricultural Library, and (4) the D. H. Hill Library, North Carolina State University, Raleigh (BIOSIS Search). In addition, CZR reviewed previous computer searches and published bibliographies to identify literature pertinent to the study.

7. A list (Appendix A) of 250 plants of wildlife value was compiled using the above information sources. In assembling this list, the study team strongly considered the applicability of each plant to dredged material areas and the plant's value to wildlife species which normally inhabit dredged material areas. Primary emphasis was placed (1) on plants that occur naturally on dredged material disposal areas and (2) on native and cultivated species known to grow under conditions closely approximating the extreme conditions often occurring on dredged material areas.

8. During the plant selection process, the study team referred to literature on plant and/or animal species occurring on dredged material areas. The most comprehensive reference of this kind was A Comprehensive Study of Successional Patterns of Plants and Animals at Upland Disposal Areas (Coastal Zone Resources Corporation 1977), a DMRP study conducted in 1973-74 for WES. The report discusses in detail the plant and animal succession on upland dredged material areas in five locations on Corps-maintained waterways: Nott Island, Connecticut; Hillsborough Bay, Florida; Atchafalaya River, Louisiana; High Island, Galveston Bay, Texas; and Mott Island, Columbia River, Oregon.

9. The other pertinent dredged material references examined are listed below:

- a. Dabydeen and Koch (1977) discuss the vegetation and floristics of a sand dredged material deposit at Barker's Island in Superior Harbor, Douglas County, Wisconsin.
- b. McVaugh (1947 and 1957) discusses establishment of vegetation on sand flats along the Hudson River, New York.
- c. Sweeny (1973) presents the ecological status of diked disposal sites in Buffalo Harbor, New York.
- d. Soots and Parnell (1975b) present the ecological succession of breeding birds in relation to plant succession on dredged material islands in North Carolina.
- e. Beaman (1973a and 1973b) and Carlson (1973?) interpret patterns of succession on dredged material islands on the west coast of Florida (primarily in Sarasota Bay and Charlotte Harbor).
- f. Montz (1972) discusses a study of the vegetation on levees in East St. Charles Parish, Louisiana.
- g. Spindler (1973) and Spindler and Noble (1974) discuss the plant species and their relative abundance and frequency on dredged material banks of Superior Canal in Cameron Parish, Louisiana.
- h. Monte (1974) discusses vegetational succession on dredged material banks in the Bayou Lafourche Basin, Louisiana.
- i. Montz (1976) reports on a 1-year vegetative survey on dredged material areas in Atchafalaya Bay, Louisiana.
- j. Barnes (1971) presents a vegetational analysis as part of her work on an island near the mouth of Baffin Bay in Kleberg County, Texas.

- k. Smith (1975) includes descriptions of the flora and fauna of Grays Harbor, Washington.

10. Regional floral and faunal literature provided the study team information on indigenous biota. Publications dealing with coastal and riverine areas were especially useful, since most dredging efforts occur in such areas; examples of such publications include Dune Formation and Stabilization by Vegetation and Plantings (Davis 1957), The Birds, Mammals, Reptiles, and Amphibians of Cape Hatteras National Seashore Recreational Area (Quay 1959), Plants of the Oregon Coastal Dunes (Wiedemann et al. 1969), Seacoast Plants of the Carolinas (Graetz 1973), and "Coastal Vegetation" (Halverson and Dawson 1973).

11. For wildlife-use information, the study team first consulted general information sources such as Native Woody Plants of the United States--Their Erosion-Control and Wildlife Values (Van Dersal 1938), Food of Game Ducks in the United States and Canada (Martin and Uhler 1951), American Wildlife and Plants (Martin et al. 1951), and Attracting Birds: From the Prairies to the Atlantic (Davison 1967). Then more specific accounts of plant and animal species were reviewed. (Many of these specific references are not cited in text and thus do not occur in the Literature Cited; however, these references are listed in the Bibliography.)

12. CZR botanists indexed the list of 250 plants by state (within the contiguous United States) and life form (trees, shrubs, vines, herbs, and grasses). Ranges and life forms of the plant species were derived from state floristic treatments, such as Manual of the Vascular Flora of the Carolinas (Radford et al. 1968) and Flora of Missouri (Steysmark 1963). Other manuals referred to included ones treating particular regions, such as the Flora of the Pacific Northwest (Hitchcock and Cronquist 1973). Several studies were confined to even more local sites; for instance, Plants of the Oregon Coastal Dunes (Wiedemann et al. 1969) proved especially helpful in establishing the distribution of some plant species under consideration. Treatments of particular groups of plants, for example, Woody Vines of the Southeastern United States (Duncan 1975), supplied usable range and

descriptive information.

13. From the preliminary list of 250 plants, the study team selected 100 plants with greatest potential value for terrestrial wildlife habitat development on dredged material areas nationwide. The primary criteria used to select these plants were (1) importance to wildlife, (2) ease of establishment, and (3) geographic distribution. A secondary criterion was to include a balance of plants exhibiting the ability to grow in:

- a. sand,
- b. soils with low fertility,
- c. soils with high salt concentrations,
- d. soils with low pH,
- e. soils with high pH,
- f. extremely moist soils, and
- g. extremely dry soils.

14. For each species, the study team prepared a species synopsis, including the scientific name, authority, and common name, along with a range map and illustration. The synopses are listed in the following format:

- a. description and life history,
- b. habitat,
- c. soil requirements,
- d. establishment and maintenance,
- e. disease and insect problems,
- f. wildlife value, and in some cases,
- g. comments.

PART III: SUGGESTED APPROACH TO TERRESTRIAL WILDLIFE
HABITAT DEVELOPMENT ON DREDGED MATERIAL

15. In recent years, there has been a trend toward increased dredged material disposal on upland, or terrestrial, sites as opposed to disposal in marsh or open-water areas. This trend is likely to continue. Upland sites include the mainland, natural islands, and previously created dredged material islands. Whatever the original nature of the disposal site--whether it is upland, marsh, or open water--the result of deposition often is a terrestrial dredged material site. Throughout this handbook the terms terrestrial and upland are interchangeable and refer to land areas above the normal waterline in nontidal areas or above mean high tide level in tidal waters. These land areas may be on the mainland or may be islands surrounded by expanses of open water or marsh.

16. Dredged material is now considered to be a potentially manageable resource rather than simply a waste product. The merits of managing these sites have been explored by various individuals, universities, and federal agencies, especially the Corps. WES has sponsored a number of studies relating to establishment and use of upland disposal sites. Some of these studies involved plants, plant establishment (both natural succession and artificial establishment), and wildlife on upland dredged material areas. For example, of eight DMRP-funded habitat development field sites across the country, three sites (located in Oregon, Texas, and Connecticut) included upland habitat development. These sites were subjected to experimental vegetation establishment and were monitored for plant survival and production as well as for animal use of the new habitat. Summary reports on these three sites will be available in October 1978. Five synthesis reports consolidating and interpreting data collected by the HDP will be available by December 1978.

17. Persons involved in future terrestrial wildlife habitat development efforts will find the WES studies useful in understanding potential problems, constraints, or possibilities related to dredged

material management. A WES publications list can be obtained upon request from U. S. Army Engineer Waterways Experiment Station, ATTN: Ms. D. P. Booth, P. O. Box 631, Vicksburg, Mississippi 39180.

18. WES wildlife biologist, L. Jean Hunt (1976), presents the concept of upland wildlife habitat development on dredged material in the Proceedings of World Dredging Conference VII. Hunt outlines an approach for upland habitat development planning and subsequent management efforts; most of Hunt's ideas are reflected in the following suggested general approach to developing terrestrial wildlife habitat on dredged material areas.

19. In planning and initiating wildlife habitat development efforts, one must consider a variety of influencing factors such as soil conditions, size of site, location of site, plants and animals presently on the site or in nearby areas, natural succession typical of the area, wildlife for which one desires to manage, flooding conditions, economic considerations, and the probability of future dredged material deposition. The following section suggests a general approach to follow after the decision has been made to develop terrestrial wildlife habitat on a selected dredged material area. This approach assumes that legal restrictions, site availability, site capacity, and other legal, administrative, or engineering aspects are favorable.

20. Terrestrial wildlife habitat development may occur for two kinds of sites: (1) an established dredged material site where deposition has been completed, and (2) a site proposed for deposition of dredged material. The former, an established dredged material site, may be many years old or relatively new, vegetated or unvegetated; a proposed site may be an existing terrestrial site or a marsh or open-water site which will become a terrestrial site when dredged material is deposited. The following approach is designed for the situation where dredged material deposition has been proposed but not yet accomplished. Some of the steps outlined below would be conducted concurrently and not necessarily in the order indicated. The approach would need to be modified somewhat if the dredged material has already been deposited.

Evaluation of the Site

21. Evaluation of the site involves numerous considerations and, therefore, can be most effectively accomplished by a multidisciplinary team, generally including a wildlife biologist, botanist, soil scientist, engineer, and, in some cases, an administrator, planner, and/or lawyer. The Corps does not have sole responsibility for determining wildlife habitat goals. According to the 1958 Fish and Wildlife Coordination Act, their responsibility is shared with the USFWS and local state fish and game departments who must be consulted about water resources-related actions. Habitat development should be a cooperative effort, with the Corps providing the raw material and technical guidance for its use and the wildlife agencies providing the direction. Local and regional SCS personnel may also be requested to assist in evaluating the site and suggesting management practices.

Sediment Characteristics

22. Since the dredged material will be the medium supporting plant life on the site, the chemical and physical characteristics of the sediments must be determined. Sediment samples from the channels, harbors, or other areas to be dredged may be collected by piston core or sampling dredge. Chemical tests should determine nutrient levels, salinity, heavy metals, or other chemical limitations to plant growth. The most important physical test is grain-size analysis since grain size influences moisture-holding capacity, nutrient content, and contaminants. Tests of the physical nature of the sediments will also determine possible construction or deposition constraints or other potential problems.

Topography and Configuration

23. The potential topography and configuration of a proposed dredged material disposal site will depend, to a considerable degree, on the amount of dredged material available for deposition as well as the topography of the disposal area prior to sediment deposition. Given a fixed amount of dredged material, deposition to construct higher elevations will result in smaller surface areas, and larger surface

areas will result in lower elevations; thus, establishing a balance between land use, flooding potential, and other factors must be considered. Factors to consider in determining the desired topography and configuration include (1) local tides, water currents, and storm occurrences which might erode the area, (2) potential flooding, (3) existing vegetation and wildlife on the site, (4) adjacent land uses, (5) possible effects on waterway traffic, and (6) future deposition plans or needs for the area.

Compatible Land Use

24. Surrounding land use should be considered to determine what, if any, terrestrial wildlife habitat development on the site is warranted, desirable, and compatible. Adjacent heavily developed, man-dominated areas such as housing developments, industries, airports, or heavily traveled roads or channels could greatly reduce the value of the habitat for desired animal species. Seasonal uses by man may affect the value of an area for a particular wildlife use but not for others. For example, an area frequented by fishermen or vacationers in spring and summer months may not be suitable for shorebird breeding activities; however, the same area may provide an ideal resting area for shorebirds and a feeding-resting area for waterfowl during fall and winter months.

Size and Location

25. The potential size of a proposed disposal area should be considered in relation to its location; these interrelated factors determine an area's potential value for wildlife. Small areas may offer no appreciable habitat development potential, whereas large areas may offer numerous management possibilities. With the current trend toward disposing on upland diked disposal sites will probably come a trend toward larger disposal sites as well.

26. Location of the site is extremely important, perhaps much more so than the size. For example, a 2-acre* terrestrial site surrounded by marsh and located very close to the mainland may support

* A table of factors for converting U. S. customary units of measurements to metric (SI) can be found on page 12.

a larger variety of wildlife species than a 10-acre island site with similar habitat but isolated by open water from marsh and mainland wildlife populations. The smaller site may often be used by typical marsh inhabitants, such as rails, herons, egrets, and raccoons; it may be visited by deer and many small land birds from the mainland; and it may support a high marsh rabbit population due mainly to the abundance of surrounding marsh vegetation. Natural plant succession and dispersal of animal species occur quickly and easily due to the area's proximity to plant and animal sources. The island site, although larger, may be used only by birds. Natural succession and animal dispersal to the island are slower due to the island's isolation. Often dredged material islands are the only areas available to colonial nesting birds, and the isolation is an advantage, since predator populations and human disturbance are decreased.

Plants and Animals on or Adjacent to the Site

27. The indigenous terrestrial plants and animals on or near the proposed disposal site should be determined. Knowledge of animal populations currently existing on or adjacent to the site is extremely important in determining the wildlife habitat goal(s) for the dredged material area. Knowledge of existing plant species on or adjacent to the site will facilitate the selection of plant species to use for wildlife habitat development on the site. The indigenous plants may be desirable for wildlife habitat development purposes and may provide a source of seeds or plant stock.

Flooding

28. If a proposed dredged material disposal area will be subject to flooding, the frequency, duration, depth, and physical and chemical effects of such occurrences should be estimated. This information is significant in determining wildlife habitat goals and selecting plant species because flooding can restrict the wildlife and the plant species which can occur on the area.

Future Dredged Material Deposition

29. Plans for continued dredged material deposition should be considered. The frequency of future dredging activities and estimates

of quantities of material to be disposed will determine the potential of a site for wildlife habitat development. If it is probable that an area will not be disposed on again, a long-range planting plan involving tree and shrub species is a possibility. However, if an area will be disposed upon every few years, then a short-term plan involving the use of fast-growing grasses and herbs is practical.

Determination of Wildlife Habitat Goal(s)

30. Determining a wildlife habitat goal for a proposed upland disposal area consists of (1) deciding what species of wildlife to manage for, (2) determining the habitat requirements for those particular wildlife species, and (3) deciding on the level of effort or intensity of the management effort.

31. Hunt (1976) states that the primary considerations for determining the goal of habitat development are (1) local considerations (i.e., the presence of any rare, endangered, or threatened species as defined by law; any type of threatened habitat; and recreation needs of the people in the area and likely to use the site), (2) regional considerations (i.e., legally protected species, threatened habitat, and overall status of animal populations), and (3) wildlife needs. Other important considerations include (1) the cost of a development project in relation to the budget for the disposal site, (2) the future plans for deposition on the site, (3) the level of maintenance needed once initial establishment is completed, (4) the managing agency, (5) the funding agency, (6) other needs or benefits from the development program (e.g., substrate stabilization and erosion control), and (7) the timetable for planning and implementation.

32. The terrestrial wildlife species that presently use the area or adjacent areas should be a main consideration in determining the wildlife habitat goal. If the selected disposal site is already desirable terrestrial wildlife habitat, then the best option may be to deposit dredged material so as to minimize disturbance of the existing habitat and to manage the newly deposited area to complement its

surroundings. For example, a previously constructed dredged material island is surrounded by open water and saltmarsh along the Atlantic or Gulf Intracoastal Waterways. The island is dominated by shrubby habitat with a few young trees and a small amount of open grassland habitat. The area supports a marsh rabbit population and is used by mourning doves, several species of rails, and a variety of nongame birds, including herons, egrets, and ibises which nest in the shrub-tree thicket. In this case, the most desirable habitat development plan might be to conduct disposal activities during nonbreeding periods, concentrate dredged material disposal in selected shrub and grassland areas, and avoid the heron/egret/ibis rookery. Then the newly deposited dredged material areas could be managed as open habitat planted with selected herbs and grasses. Thus, the management scheme would complement the existing habitat, maximize the benefit to existing species, cause the least disruption to existing wildlife, and require only minimal habitat development efforts (time, materials, and money).

33. Another example is a small, sparsely vegetated island remote from the mainland and inhabited only by birds--the island's primary wildlife value is as a shorebird and waterbird nesting area. The simplest habitat development plan may be to deposit dredged material on the island during the birds' nonbreeding season and allow natural vegetative succession. Many shorebird and waterbird species nest on bare substrate or among herbaceous or shrubby vegetation of early stages of plant succession. Thus, long-term active management of an area for these birds may consist of reversing or arresting the stage of natural succession by deposition of additional dredged material or by removal of vegetation.

34. Rare, endangered, or threatened species (as defined by either state law or the 1973 Endangered Species Act--PL 93-205) which occur or are likely to occur on the proposed site may warrant specific management. The Federal endangered and threatened species list and the 50 state lists (official and unofficial) are compiled in Management of Transmission Line Rights of Way for Fish and Wildlife for Evaluation Purposes, a study conducted for the USFWS by Asplundh Environmental

Services. This report, presently in draft, will be available in January 1979 (Personal Communication, January 1978, Dr. Kenneth Hoover, National Power Plant Team, USFWS, Ann Arbor, Michigan).

35. Once the wildlife species have been selected, their habitat requirements must be considered. The primary components of wildlife habitat are food, cover, and water. The kinds, amounts, and arrangements of these components required vary from one animal species to another. For example, some animals can subsist with no water, some can drink salt water, and others require fresh water. Some animals require only one habitat, but others need a diversity of habitats. Specialized seasonal food or cover requirements must be considered.

36. If a selected species is highly mobile or migratory and only a seasonal resident or occasional visitor to the site, then only a portion of its requirements (usually food or temporary cover) must be met. For example, many geese and ducks breed north of the contiguous United States and winter along the Atlantic, Gulf, and Pacific coasts. Dredged material areas in or adjacent to the waters frequented by these birds may be used as resting and feeding sites and thus managed as such--no need exists to plan for nesting cover for these species. The highly mobile mourning dove may visit some dredged material sites to feed or obtain grit but may nest or roost elsewhere. Dredged material areas which receive deposition every few years and which are located adjacent to woodlands supporting established deer and turkey populations may be managed to provide quickly established herbaceous food plants for these and other wildlife species.

37. Although it may be necessary or beneficial to provide for only specialized needs of some migratory species, permanent residents on a site must be provided all of their life requirements. These include a year-round food supply and the needed cover types to provide escape cover, protection from inclement weather (cold, rain, snow, wind, summer heat), nesting sites, and other specialized needs.

38. An experienced wildlife biologist or vertebrate ecologist should assist in determining the species for which to manage on a particular site; the biologist should subsequently determine the habitat

requirements for those wildlife species. The information, references, and literature sources outlined in Part IV and the selected literature references in the Bibliography are intended to assist in these determinations. An excellent reference is Wildlife Management Techniques (Giles 1969); this text contains an extensive Literature Cited section dealing with wildlife species and various aspects of their management. Input should be solicited from local USFWS personnel and especially from the state's wildlife agency.

Selection of Plant Species

39. Once the wildlife habitat development goals have been determined, the plants needed to provide the food and cover for desired wildlife species can be selected. Ideally, plant selection should be the joint effort of a wildlife biologist and a botanist.

40. The 100 plants discussed in this handbook were selected because of their suitability for wildlife habitat development on upland disposal sites. To determine the applicability of these plants to a specific region, refer to Table 1 in which the plants are indexed by state and to Table 2 in which their adaptability to various extreme soil conditions is given. (These tables are at the beginning of Part VI.) After selecting species which correspond to the disposal area's location and soil conditions, refer to the species synopses for additional information to determine if those plants will meet the desired habitat development goals.

41. As a rule, native plant species have definite advantages for use in wildlife habitat development: (1) the wildlife of the area normally depend on these plants; (2) the plants are adapted to the climate and to the physical and chemical properties of the local sediments; (3) native plant species are usually less susceptible to disease and insect damage than cultivars; and (4) native species are less likely to spread out of control.

42. In some cases commonly cultivated crops, such as the cereal grains (e.g., corn, wheat, barley, and rye) and species developed and

used for wildlife plantings and erosion control (e.g., bicolor lespedeza, autumn olive, multiflora rose, and reseeded soybean), may provide additional benefits that the native species cannot. Technical assistance in establishing many of these cultivated plants should be sought from the state wildlife agency, the SCS, the U. S. Forest Service (USFS), and local agricultural extension agencies.

43. Many of the species that are adaptable to dredged material disposal sites and have considerable wildlife value are also problem weeds of agricultural lands. Care must be taken to avoid introducing pest species on sites from which they may spread to previously uninfested cultivated lands.

44. In most cases, a variety of plant types creating a diversity of habitats will be desirable; however, for certain management goals homogeneous stands of a single species or of one kind of habitat may be in order. For example, if the management goal is to attract and maintain stable populations of as many wildlife species as possible, while emphasizing productive small game habitat, then a mixture of trees, shrubs, herbs, and vines should be used to develop a variety of biotic communities. If the management goal is to provide an upland waterfowl feeding area, then a homogeneous stand of a grain or forage crop may be used.

45. In some cases using appropriate management techniques can accelerate or arrest natural succession to maintain the seral stage necessary to satisfy the needs of particular species of wildlife. Such techniques include cutting or harvesting, controlled burning, and selective deposition of dredged material. On some sites no habitat development may be the preferred course.

46. Only plant species that can be readily established and easily maintained on the site should be selected. For large areas accessible to machinery, species which can be planted, fertilized, and cultivated by machine may be expedient. For small and/or inaccessible areas, select species that can easily be planted and maintained by hand.

47. Future deposition plans for a site limit the kinds of plants that can be successfully established. Sites which will receive periodic

deposition may be intensively or passively managed but only for short intervals. Fast-growing grasses, herbs, and vines are the best plant choices for these areas. For long-term development efforts, trees and shrubs may be used in combination with quickly established species.

Preparation of Site

48. The configuration of the proposed site should be planned based on the prior site evaluation (including a topographic survey of the proposed disposal site, the estimates of the volume of material to be dredged, the nature of the dredged material, etc.) and on the wildlife habitat development goal. The proposed configuration, necessary site preparations, and deposition of sediments should be planned to minimize damage to existing productive habitat. In some cases, woody vegetation may need to be removed. Retaining structures, preferably earthen or sand dikes which can be vegetated, will generally be used to contain the dredged material. These structures may need to be reduced to site elevation once the dredged material has drained and consolidated.

Deposition of Sediments

49. If current trends continue, most sediments will be placed on diked dredged material sites by means of hydraulic pipeline dredges. Depending on the nature of the sediments, some landscaping and elevation variation may be possible. For more information refer to WES publications relating to techniques and mechanics of dredged material deposition and subsequent handling; e.g., Landscape Concept Development for Confined Dredged Material Sites (Mann et al. 1977) or Productive Land Use of Dredged Material Containment Areas: Synthesis Report (Walsh and Malkasian 1978).

Preparation of Substrate

50. Substrate preparation can proceed as soon as the dredged material has dewatered sufficiently to allow working the soil. Some sites will require no substrate preparation for desired vegetation growth, but other sites may require modification of site and soil conditions (by chemical, physical, or biological means) to support growth of desired food and cover plants. Plowing to mix surface layers, break up fused clods (characteristic of fine organic and clay deposition), or to remove existing vegetation may be needed. Acid soils may be limed to increase the pH, and infertile sediments may be fertilized. Highly saline soils may be treated with gypsum, planted with a salt-tolerant plant, or simply left to leach over a period of time. Earth-moving equipment may be needed to level or fill in areas as needed.

51. Substrate preparation needs should be determined by a soil scientist and botanist. A complete soil analysis should be performed. Even if sediment analyses were performed on the dredged material before dredging, particle-size distribution and other characteristics may be somewhat different. Oxidation of sediments may result in altered pH and chemical constituency, especially in marine sediments. Salt content is, of course, a particular problem in estuarine settings. Based on the analyses and the needs of selected plant species, decisions as to timing, amount, and periodicity of chemical addition (fertilizers, lime, gypsum) or other substrate modifications can be made.

Establishment and Maintenance of Vegetation

52. The establishment and maintenance of the vegetation on dredged material sites are discussed in detail in Part V.

PART IV: WILDLIFE IN TERRESTRIAL HABITATS ON DREDGED MATERIAL

53. Terrestrial habitats on dredged material areas across the contiguous United States support highly diverse wildlife populations. The purpose of this section is (1) to provide general distribution information on some of the more prevalent and important animals for which terrestrial wildlife habitat development on dredged material might be considered, and (2) to provide references and information sources related to these animals.

54. To determine which animals occur on or adjacent to proposed dredged material sites, one can rely on (1) site visits, (2) contacts with knowledgeable persons or agencies, and (3) literature references. A combination of these is preferable, but in some cases all would not be necessary. A site visit should preferably be conducted by an experienced wildlife biologist who would determine the existing habitat and the primary wildlife species present on or adjacent to the site. Wildlife species would be identified by direct sightings or observations of tracks, scats, nests, dens, or other signs. Migratory species which use the area only during certain seasons may be missed. Thus, additional site visits may be warranted, or contacts and literature information may serve to complement or confirm preliminary findings.

55. Contacts which may provide useful wildlife information include state wildlife agency personnel (especially the wildlife biologist assigned to the local region), local USFWS personnel, local environmental consultants, university personnel with appropriate wildlife or zoology backgrounds, natural history museum personnel, and local hunters or naturalists.

56. Literature references relating to wildlife are extensive and diverse. Some of the more applicable general references are mentioned below (and are listed in the Literature Cited). These general references often list many specific references, and each succeeding reference may lead to others. Additional references are listed in the Bibliography.

57. Bibliographies for particular species or wildlife types, such as A Contribution Toward a Bibliography on the Beaver by Yeager and Hay (1955), or A Contribution Toward a Bibliography on California Furbearers by Newberry (1973), are sometimes available, and review papers containing extensive bibliographies can be located by checking published indexes. The major indexing-abstracting publications pertinent to wildlife include Biological Abstracts, Bioresearch Index, Zoological Record, Bibliography of Agriculture, and Biological and Agricultural Index.

58. One major review service dealing exclusively with current published wildlife literature is sponsored by the United States Department of the Interior, USFWS. Wildlife Review, published several times a year, lists titles by subject. A geographic index gives a coded list of titles pertinent to individual states and to other identifiable regions and political units.

59. Approximately every 10 years all of the Wildlife Review citations are compiled to form a volume of Wildlife Abstracts. Titles are arranged by subject here, also, and within subjects they are listed in alphabetical order by the author's last name. Additional reference tools found in Wildlife Abstracts include an author index, a subject index, an index of scientific equivalents of common names, and an index of bibliographic sources.

60. One simple and cost-effective method of identifying pertinent wildlife literature is to obtain a computer literature search from the Fish and Wildlife Reference Service (FWRS), Building I, 3480 York Street, Denver, CO 80205, 303/571-4656. Contact them, explain your project briefly, and give their specialists specific information on the animal species involved, the geographic areas, and the time period you want to cover, if applicable. Government reports, most notably unpublished federal aid reports, make up the major portion of the FWRS data files. The FWRS can provide users with copies of material not readily available elsewhere. The quarterly FWRS Newsletter provides up-to-date information on their services.

61. Other computerized literature services are available, and college or university librarians can provide details on the wide-ranging costs and procedures involved in using these specialized sources.

62. Most state wildlife agencies have literature available, ranging from summary leaflets about a particular species to extensive, detailed books or pamphlets on wildlife (especially game species) and their management. For example, the California Department of Fish and Game has available such publications as Furbearers of California (Seymour 1968), Upland Game of California (Mallette 1970?), Waterfowl of California (Kozlik 1974), Big Game of California (Dasmann 1975), and others. In some states, the state museum of natural history may also have useful references and information sources.

63. Wildlife species lists will often be available from Corps (or other agency) Environmental Impact Assessments (EIA's) or Environmental Impact Statements (EIS's) of dredging projects, from other nearby project EIA's or EIS's, or from nearby park or refuge lists. Most USFWS wildlife refuges and most state and federal parks keep updated wildlife species lists. Some parks or refuges have other wildlife information available as published pamphlets or information sheets, or they will supply needed information on request.

64. References on wildlife on dredged material are available from WES (e.g., A Comprehensive Study of Successional Patterns of Plants and Animals at Upland Disposal Areas, Coastal Zone Resources Corporation 1977) and from the national Sea Grant Program (e.g., Ecological Succession of Breeding Birds in Relation to Plant Succession on Dredge Islands in North Carolina, Soots and Parnell 1975b). Summary reports of DMRP habitat development field sites give results of experimental vegetation establishment on dredged material and subsequent animal use. Sites are located in Oregon, California, Texas, Georgia, Virginia, and Connecticut. These reports will be available by October 1978. Numerous thesis studies of wildlife on dredged material areas have also been conducted.

65. Birds are the most numerous and diverse users of dredged material areas. For accepted nomenclature of bird species, refer to the American Ornithologists' Union's Checklist of North American Birds

(1957) and its supplements (1973, 1976). General information and distribution can be found in such field guides as Peterson (1961, 1967), Robbins et al. (1966), Bull and Farrand (1977), Udvardy (1977), or general works, such as The Audubon Illustrated Handbook of American Birds (Reilly 1968). Detailed life history accounts of American bird families are presented by Bent (1919-1968). Ornithology in Laboratory and Field (Pettingill 1970), a comprehensive aid to ornithological study, contains extensive bibliographic references and a list of current ornithological journals (national, regional, and state). Many states have a state publication such as Birds of North Carolina (Pearson et al. 1959), Louisiana Birds (Lowery 1960), and Birds of Oregon (Gabrielson and Jewett 1940); these are also listed in Pettingill (1970). The National Audubon Society sponsors regular Christmas bird counts and winter and nesting censuses which are compiled and published in American Birds.

66. Mammals, though not as diverse and abundant as birds, are very important faunal components of dredged material areas. No one reference is standard for common and scientific nomenclature of mammals; however, the Revised Checklist of North American Mammals North of Mexico (Jones et al. 1975) is a recent attempt to standardize the nomenclature. Distribution and general information can be found in such nationwide references as A Field Guide to the Mammals by Burt and Grossenheider (1964) and The Mammals of North America (Hall and Kelson 1959) or in such state or regional publications as Mammals of the Pacific States (Ingles 1965), The Mammals of Texas (Davis 1966), Mammals of Maryland (Paradiso 1969), The Mammals of Louisiana and Its Adjacent Waters (Lowery 1974), A Checklist of North Carolina Mammalian Species (North Carolina Wildlife Resources Commission 1974), and The Wild Mammals of Missouri (Schwartz and Schwartz 1974).

67. Reptiles and amphibians are not as well known or highly regarded as birds and mammals; nevertheless, they are regular and often common faunal constituents on many dredged material areas. The most current and complete reference is A Field Guide to Reptiles and Amphibians of Eastern and Central North America by Conant (1975). Other

pertinent general references include A Field Guide to Western Reptiles and Amphibians (Stebbins 1966) and The New Field Book of Reptiles and Amphibians (Cochran and Goin 1970).

Game Animals and Furbearers

68. In a previous study for WES, Dames and Moore (1977) indentified the game and furbearing animals which they felt could benefit most from habitat development on upland portions of dredged material disposal areas. These target species, selected from one or more of five major divisions (North Atlantic, South Atlantic, Great Lakes, Gulf Coast, Pacific Coast) of the contiguous United States, included nine birds and seven mammals. Most of these plus other game animals and furbearers are discussed below.

Small Game and Furbearing Mammals

69. Rabbits are the primary small game mammals occurring on dredged material areas nationwide; however, the species which occur on such areas vary with the location in the country and the habitat available. The most common and widespread species is the eastern cottontail (*Sylvilagus floridanus*) which occurs in the states east of a line from New Mexico to North Dakota, excluding the extreme northern New England states. The marsh rabbit (*Sylvilagus palustris*) is a common inhabitant of dredged material areas in coastal and coastal plain sites from southern Virginia to Alabama. The swamp rabbit (*Sylvilagus aquaticus*) is a major inhabitant of suitable dredged material in the Mississippi River Valley and Gulf coast states. The brush rabbit (*Sylvilagus bachmani*) is the major species along the Pacific coast, and the desert cottontail (*Sylvilagus audubonii*) occurs throughout the southwestern part of the country. The black-tailed jack rabbit (*Lepus californicus*) occurs primarily in the western United States roughly west of a line from eastern Texas to eastern South Dakota, and the white-tailed jack rabbit (*Lepus townsendii*) occurs throughout most of the western United States north of a line along borders of Arizona, New Mexico, and Oklahoma.

The snowshoe hare (*Lepus americanus*) occurs primarily in states along the Canadian border.

70. Rabbits are prolific and will quickly populate a dredged material site if the site has suitable habitat and is available to existing rabbit populations. Habitat development for rabbits can be reasonably accomplished on many dredged material areas and will benefit other animals as well. Many small mammals and birds will use the cover and foods provided. Predatory birds and furbearing mammals will both use the available cover and prey on the birds and small mammals present, including the rabbits.

71. Furbearing mammals which occur on dredged material areas are primarily carnivorous or omnivorous. The striped skunk (*Mephitis mephitis*) and eastern spotted skunk (*Spilogale putorius*) are the two most common skunk species and inhabit most of the contiguous United States. The red fox (*Vulpes vulpes*) occurs in almost every state and the gray fox (*Urocyon cinereoargenteus*) in all but several northwestern states. The coyote (*Canis latrans*) occurs throughout most of the United States except for the Southeast--but this adaptable creature is gradually extending its range eastward. The raccoon (*Procyon lotor*) is distributed nationwide, and the opossum (*Didelphis virginiana*) occurs in most states east of Colorado and along the Pacific coast. These furbearing mammals are omnivorous but usually take mostly animal food. Management of terrestrial dredged material areas specifically for these furbearers would be difficult and not especially productive. However, providing good habitat for small game and bird species which are more abundant and more responsive to management would indirectly benefit these furbearers as well. Such management efforts would likely provide some plant foods and cover used by the furbearers and would increase the numbers of birds and small mammals upon which the furbearers often feed. For literature relevant to furbearers, refer to A Contribution Toward a Bibliography on California Furbearers by Newberry (1973).

72. Three semiaquatic furbearers, the beaver (*Castor canadensis*), muskrat (*Ondatra zibethicus*), and nutria (*Myocastor coypus*) may occasionally visit upland sites. They are primarily herbivorous; however,

muskrats and nutria occasionally take minor amounts of animal food. The muskrat, which occurs practically nationwide, typically feeds on aquatic vegetation in marshes, ponds, lakes, and streams but occasionally ventures onto adjacent uplands to feed. They commonly burrow into the dikes or banks of dredged material areas. Nutria occur in wetlands in eastern Virginia and North Carolina, in scattered areas throughout the Southeast and Texas, and in isolated spots in the Rockies, northern Nevada, and western Washington and Oregon. Like the muskrat, they occasionally burrow into dikes or banks of disposal areas or venture onto adjacent uplands to feed. An excellent reference is About Nutria and Their Control (Evans 1970). The beaver, with practically nationwide distribution, was at one time greatly reduced in range and numbers. In recent years, however, the beaver has made a significant comeback, especially in the Southeast. Although the muskrat, nutria, and beaver sometimes venture onto upland disposal areas, management for these species would be more reasonably directed toward wetland areas.

Large Game Mammals

73. The primary large game mammal in the eastern U. S. and on dredged material areas is the white-tailed deer (*Odocoileus virginianus*) which occurs throughout the United States except for the southwest desert area and most of California. The mule deer (*Odocoileus hemionus*) is the most important large game species in the western United States and occurs roughly west of a line from the panhandle of Texas to Minnesota. Most dredged material disposal areas are too small to support significant permanent deer populations, too remote from established herds, or disposed on too often to allow appropriate vegetation to develop. However, when disposal areas are located adjacent to large tracts of good deer habitat, they can be managed to provide food and some cover for local established populations. References include The White-tailed Deer in Wisconsin (Dahlberg and Guettinger 1956), The Deer of North America (Taylor 1956), If Deer Are to Survive (Dasmann 1971), and many others.

Game Birds

74. Migratory Game Birds. Migratory game birds which may make significant use of dredged material areas include waterfowl, doves, rails, and crows. A suggested general reference which discusses many such species is Management of Migratory Shore and Upland Game Birds in North America (Sanderson 1977).

75. Waterfowl users of upland dredged material areas are primarily geese and surface-feeding ducks which often leave the water to feed on land. Canada geese (*Branta canadensis*), white-fronted geese (*Anser albifrons*), and blue and snow geese (*Chen caerulescens*) may use suitable dredged material areas for feeding or resting, primarily during the fall and winter months when they are on (or migrating to) their wintering grounds. Small numbers of Canada geese may also use dredged material areas for nesting, but white-fronted geese, snow geese, blue geese, and most Canada geese nest far to the north of the contiguous United States. The mallard (*Anas platyrhynchos*), black duck (*Anas rubripes*), pintail (*Anas acuta*), gadwall (*Anas strepera*), American wigeon (*Anas americana*), blue-winged teal (*Anas discors*), American green-winged teal (*Anas crecca carolinensis*), and wood duck (*Aix sponsa*) are surface feeding ducks which often feed on upland areas. If suitable food sources were available on dredged material areas adjacent to waters frequented by such species, waterfowl use could be expected. Some of these surface-feeding species as well as the redhead (*Aythya americana*), ruddy duck (*Oxyura jamaicensis*), and red-breasted merganser (*Mergus serrator*) nest within the contiguous United States and might use suitably vegetated dredged material sites.

76. The most recent and complete waterfowl references are Ducks, Geese, and Swans of North America (Bellrose 1976), an expanded version of an earlier work of the same title by Kortright (1967), and Waterfowl of North America (Johnsgard 1975). In addition to the extensive direct information given, each provides an excellent list of references.

77. The mourning dove (*Zenaida macroura*) is the most abundant and widespread dove in the United States and commonly occurs on dredged material areas. Such areas often include sandy substrate where doves

obtain grit, open areas where they feed on seeds of grasses and herbs, and tree-shrub thickets where they roost, nest, or find cover from inclement weather or predators. The potential for successful management of dredged material areas for the common, highly mobile mourning dove is good. Most dredged material sites will be used, with or without management; management of most dredged material sites to enhance the available food and cover will be productive, especially if sources of fresh water and grit are available as well.

78. Rails are primarily marsh birds, but they will venture onto adjacent upland habitats. Dredged material areas (especially islands surrounded by saltmarsh along the Atlantic coast) are frequented by clapper rails (*Rallus longirostris*) and occasionally by Virginia rails (*Rallus limicola*), soras (*Porzana carolina*), and king rails (*Rallus elegans*). The rails move from the marshes into the cover of adjacent upland dredged material areas primarily during periods of high tide, especially extreme high storm tides and spring tides. They sometimes roost on the dredged material areas. The clapper rail is primarily a saltmarsh inhabitant along the Atlantic, Gulf, and Pacific coasts. The Virginia rail, sora, and king rail more typically inhabit fresh or brackish marshes. No upland habitat management efforts would be warranted for rails.

79. Crows are common inhabitants of dredged material areas. The common crow (*Corvus brachyrhynchos*) is the most widespread, occurring nationwide. The fish crow (*Corvus ossifragus*) ranges along the Atlantic and Gulf coasts and inland along major waterways. The northwestern crow (*Corvus caurinus*) occurs primarily along the west coast of Washington.

80. Crows are highly adaptable, intelligent birds. They are generally considered undesirable pests because of their depredations on agricultural crops and on the nests and young of many other birds, especially waterfowl. They have redeeming qualities as well; they are scavengers, eat insects harmful to agricultural crops, and provide sport hunting. Crows will probably benefit from any habitat development efforts directed toward other wildlife. For example, if tree-shrub cover is provided, they will use it; if food sources are provided, they will

use them; or if nesting habitat for colonial water birds is provided, they will feed on the eggs and young of the colonial nesters.

81. Nonmigratory Game Birds. Nonmigratory game birds include the wild turkey (*Meleagris gallopavo*), ring-necked pheasant (*Phasianus colchicus*), and several species of quail and grouse. The wild turkey occurs in scattered areas throughout the United States; however, few dredged material areas offer any potential for turkey management. Turkeys are wide-ranging forest game which prefer habitat that is remote from man. Most dredged material areas are outside good turkey range, receive too much human disturbance, or are much too small to support permanent turkey populations. However, some remote disposal areas, such as along a major river and adjacent to bottomland hardwoods with an established turkey population, could be managed to benefit the existing turkey population. Such areas could be planted with grasses and herbs that provide food and low cover. Such habitat is especially valuable to hens and broods for providing (1) grasses, legumes, and other low-growing food plants when forest foods may be scarce, (2) insects in greater abundance than in surrounding forest areas, and (3) dusting areas (Bailey and Rinell 1968). Suggested general references on the wild turkey are The Wild Turkey and Its Management (Hewitt 1967) and The World of the Wild Turkey (Lewis 1973). History and Management of the Wild Turkey in West Virginia (Bailey and Rinell 1968) and Management for Alabama Wild Turkeys (Davis 1976) are relevant state publications.

82. The ring-necked pheasant occurs throughout most of the northern United States, roughly north of 38° latitude. Some useful references include The Ring-necked Pheasant and Its Management in North America (McAtee 1945), Pheasants in North America (Allen 1956), Life History and Ecology of the Ring-necked Pheasant in Nebraska (Baxter and Wolfe 1973), and Montanta's Ring-necked Pheasant--History, Ecology, and Management (Weigand and Janson 1976).

83. The bobwhite (*Colinus virginianus*) is the quail species most likely to be found on dredged material sites. It is the primary game bird in the Southeast; it occurs naturally throughout the portion of the

United States east of the Rocky Mountains and has been introduced into Washington, Oregon, and Idaho. Suggested references include The Bobwhite Quail--Its Habits, Preservation and Increase (Stoddard 1931) and The Bobwhite Quail--Its Life and Management (Rosene 1969). Other common quails occurring in the West or Southwest which might occasionally inhabit dredged material areas include the California quail (*Lophortyx californicus*), Gambel's quail (*Lophortyx gambelii*), and scaled quail (*Callipepla squamata*).

84. Of the various grouse species occurring in the contiguous United States, only the ruffed grouse (*Bonasa umbellus*) is a likely inhabitant of dredged material sites. Its occurrence on such sites would be most likely in the Northwest and Great Lakes states. A suggested general reference for the quail and grouse is Grouse and Quails of North America (Johnsgard 1973).

85. Management for pheasants, quail, and grouse may be productive on some dredged material sites. On sites with established populations on or adjacent to the site, development of temporary or permanent food and cover may enhance game bird populations.

Nongame Animals

86. Specific management efforts for nongame animals are for the most part a relatively new concept. Recent interest in management of nongame species has been fostered by both federal and state rare, endangered, and threatened species legislation and increased concern by environmentalists throughout the nation. Many of the species in this section are heavily dependent on dredged material sites and probably will require management in the future if population levels are to be maintained.

Shorebirds, Wading Birds, and Water Birds

87. A wide variety of shorebirds, wading birds, and other water birds utilize dredged material sites, especially islands, at some time during the year. Shorebirds (sandpipers and plovers) of many species feed along the margins of dredged material areas or in borrow pits

on diked areas, or rest in sheltered locations on dredged material sites during their spring and fall migratory passages; a few species nest on these manmade sites. Wading birds (herons, egrets, ibises) also may feed along shallow edges or in the flooded borrow pits adjacent to dikes. At many locations they nest on dredged material islands in large numbers. Other water birds, such as gulls, terns, skimmers, and pelicans use these sites heavily for nesting and for resting.

88. The use of dredged material areas by these birds varies from region to region. Along the northeastern Atlantic coast, dredged material islands are not abundant, and their use by birds is limited. Along the Atlantic coast from about Long Island south, however, use by all groups increases and dredged material islands become important avian habitats (Buckley and Buckley 1975, Soots and Parnell 1975b, Buckley and McCaffrey 1978). Primary use in this region is for nesting sites. This high level of use continues along the Gulf coast from Florida to the Mexican border (Schreiber and Schreiber 1978, Chaney et al. 1978). Dredged material islands in the Great Lakes are not abundant but are also important nesting sites for water birds (Scharf 1977, 1978). Although there are some dredged material islands in the Mississippi River system, they are not used for nesting by colonial birds (Thompson and Landin 1978). Less dredging is done on the Pacific coast, but where dredged material islands do occur they may be used as nesting or resting sites by shorebirds and water birds (Peters et al. 1978).

89. Shorebirds generally feed, often in mixed-species flocks, along island perimeters or in borrow pits and shallow pools when such are present. Feeding activity on terrestrial sites is limited. A few species, such as the willet (*Catoptrophorus semipalmatus*), American oystercatcher (*Haematopus palliatus*), and Wilson's plover (*Charadrius wilsonia*) regularly nest on islands along the middle and south Atlantic coast. These species plus the snowy plover (*Charadrius alexandrinus*), also nest along the Gulf coast (AOU 1957). In the Great Lakes region, the piping plover (*Charadrius melodus*), killdeer (*Charadrius vociferus*

vociferus), common snipe (*Capella gallinago*), and spotted sandpiper (*Actitis macularia*) nest regularly. Along the Mississippi River, the killdeer and spotted sandpiper nest and large numbers of shorebirds pass in migration. The Life History of North American Shore Birds (two volumes) by Bent (1927 and 1929) provides detailed accounts of the lives of these birds.

90. Gulls of several species regularly nest on dredged material islands. The herring gull (*Larus argentatus*) and great black-backed gull (*Larus marinus*) nest along the Atlantic coast from New England to North Carolina (AOU 1957, Parnell and Soots 1975a), and laughing gulls (*Larus atricilla*) nest from Maine to Florida and across the Gulf coast to Texas (AOU 1957). In the Great Lakes ring-billed gulls (*Larus delawarensis*) are abundant breeders and herring gulls are also present (AOU 1957). On the west coast, glaucous-winged gulls (*Larus glaucescens*) and western gulls (*Larus occidentalis*) occasionally establish colonies on dredged material islands in Oregon and Washington (Peters et al. 1978).

91. Terns of several species also regularly establish their colonies on dredged material islands. The common tern (*Sterna hirundo*) nests in the Great Lakes, along the Atlantic coast from Maine to North Carolina, and occasionally at sites in Florida and Texas (AOU 1957). The gull-billed tern (*Gelochelidon nilotica*) nests along the Atlantic coast from Maryland to Florida and across the Gulf coast to Texas (AOU 1957). The least tern (*Sterna albifrons*) nests along the Atlantic and Gulf coasts from Massachusetts to Texas. It also occurs sparingly in the Mississippi River drainage system and on the Pacific coast (AOU 1957). The royal tern (*Sterna maxima*) nests along the Atlantic coast from Maryland to north Florida and across the Gulf coast to Texas (AOU 1957). Often associated with royal tern colonies are smaller numbers of sandwich terns (*Sterna sandvicensis*). The Caspian tern (*Sterna caspia*) nests sporadically within a wide geographic range. It is known to nest on islands in North Carolina, Florida, the Great Lakes, and on the Pacific coast (AOU 1957, Parnell and Soots 1976). The black skimmer

(*Rynchops niger*) nests along the Atlantic coast from Massachusetts to Florida and across the Gulf coast to Texas (AOU 1957).

92. Brown pelicans (*Pelecanus occidentalis*) nest at widely scattered sites, sometimes on dredged material islands, along the Atlantic coast from North Carolina to Florida and across the Gulf coast to Texas (AOU 1957). In Texas the white pelican (*Pelecanus erythrorhynchos*) also nests on dredged material islands (Chaney et al. 1978). The double-crested cormorant (*Phalacrocorax auritus*) occasionally establishes colonies along the Mississippi River, on islands in the Great Lakes, and in Florida (AOU 1957). It is replaced in Texas by the olivaceous cormorant (*Phalacrocorax olivaceus*) (AOU 1957).

93. References include Life Histories of North American Gulls and Terns (Bent 1921) and Life Histories of North American Petrels and Pelicans and Their Allies (Bent 1922).

94. All species of North American herons, egrets, and ibises are known to nest at times on dredged material sites. The great blue heron (*Ardea herodias*) nests in the Pacific Northwest, on the Great Lakes, along the Mississippi River, and along the Atlantic coast from Maine to Florida and Texas (AOU 1957). Green herons (*Butorides striatus*) regularly nest in small numbers along the Atlantic and Gulf coasts and may occasionally be found in other regions (AOU 1957). The little blue heron (*Florida caerulea*) nests along the Atlantic coast from Massachusetts to Florida and across the Gulf coast to Texas. It also nests along the southern part of the Mississippi River drainage system (AOU 1957). The cattle egret (*Bubulcus ibis*) is expanding its range in North America. It may be found along the Atlantic coast from New Jersey to Florida (Custer and Osborn 1977), across the Gulf coast to Texas (Chaney et al. 1978, Schreiber and Schreiber 1978), and in the Great Lakes region (Scharf 1978). The reddish egret (*Dichromanassa rufescens*) nests only in south Florida and along the Texas coast (AOU 1957), while the great egret (*Casmerodius albus*) nests along the Atlantic and Gulf coasts as well as along the Mississippi River, in the Great Lakes, and at a few sites in the Pacific Northwest (AOU 1957). The snowy egret (*Egretta thula*) and Louisiana heron (*Hydranassa tricolor*) nest from Maine south

along the Atlantic coast to Florida and across the Gulf coast to Texas (AOU 1957). The black-crowned night heron (*Nycticorax nycticorax*) nests along the Atlantic coast from Maine to Florida, across the Gulf coast to Texas, along the Mississippi River, in the Great Lakes, and occasionally in the Pacific Northwest (AOU 1957). The yellow-crowned night heron (*Nyctanassa violacea*) is generally less common, nesting only along the Atlantic and Gulf coasts and up the Mississippi River to Tennessee (AOU 1957).

95. The glossy ibis (*Plegadis falcinellus*) nests along the Atlantic coast from the mid-Atlantic states southward to Florida and westward along the Gulf coast where it is replaced by a close relative, the white-faced ibis (*Plegadis chihi*) (AOU 1957). The white ibis (*Eudocimus albus*) nests along the Atlantic coast from North Carolina south to Florida (Custer and Osborn 1977) and along the Gulf coast to Texas (AOU 1957). The roseate spoonbill (*Ajaia ajaja*) nests in scattered colonies on the west coast of Florida and along the Texas coast (AOU 1957). For details on the biology of these wading birds, refer to Life Histories of North American Marsh Birds by Bent (1926) and to the Handbook of North American Birds (Volume 1) by Palmer (1962).

96. All of the pelicans, cormorants, wading birds, gulls, and terns discussed above are colonial nesters that often gather into large multispecied assemblages at breeding time. For example, a single colony of wading birds in South Carolina was estimated to contain over 44,000 adult birds of three species (Custer and Osborn 1977).

97. Gulls and terns generally nest on the ground. Sites will range from bare substrate to those heavily vegetated by grasses and herbs (Bent 1921, Soots and Parnell 1975b). Pelicans may nest either on the ground or in dense shrub thickets (Bent 1922). Herons, egrets, and ibises generally nest in dense low thickets of woody vegetation or in forests. Occasionally colonies will be located in herbaceous vegetation, and nests may even be placed on the ground (Bent 1926, Soots and Parnell 1975b, Palmer 1962). All species listed are known to nest on dredged material sites (Soots and Parnell 1975b, Chaney et al. 1978, Schreiber and Schreiber 1978).

98. The use of dredged material sites has been shown to be very important to many of these colonial nesters (Buckley and Buckley 1975), Soots and Parnell 1975a and 1975b). Management for use by these birds should receive a high priority, as dredged material sites often represent critical habitats providing isolated nesting sites for a much greater number of birds than is possible when dealing with noncolonial species.

99. Some of the most up-to-date information relating to colonial nesting birds on dredged material areas is contained in the following WES study reports:

- a. A Study of the Use of Dredged Material Islands by Colonial Seabirds and Wading Birds in New Jersey (Buckley and McCaffrey 1978)
- b. The Use of Dredged Material Islands by Colonial Seabirds and Wading Birds in Texas (Chaney et al. 1978)
- c. Colonial Nesting Sea and Wading Bird Use of Estuarine Islands in the Pacific Northwest (Peters et al. 1978)
- d. Bird Use and Vegetation Succession on Dredged Material Islands in Florida (Schreiber and Schreiber 1978)
- e. An Aerial Survey of Waterbird Colonies Along the Upper Mississippi River and Their Relationship to Dredged Material Deposits (Thompson and Landin 1978)
- f. Bird Use and Vegetation Succession of Dredged Material Islands in Florida (Lewis and Lewis 1978)
- g. A Comparison of Plant Succession and Bird Utilization on Diked and Undiked Dredged Material Islands in the North Carolina Estuaries (Parnell et al. 1978)
- h. Colonial Birds Nesting on Manmade and Natural Sites in the U. S. Great Lakes (Scharf 1978)

100. Other pertinent reports or presentations prepared by WES personnel include:

- a. "Wading Birds and Wetlands Management" (Landin 1978a)
- b. "National Perspective of Sea and Wading Bird Nesting on Dredged Material Islands" (Landin 1978b)
- c. "Colonial Bird Use of Dredged Material Islands: A National Perspective" (Landin and Soots 1978)
- d. The Development and Management of Avian Habitat on Dredged Material Islands (Soots and Landin 1978)

101. Other important references are:

- a. The Significance of Dredge Spoil Islands to Colonial Nesting Waterbirds in Certain National Parks (Buckley and Buckley 1975)
- b. Wading Birds As Biological Indicators: 1975 Colony Survey (Custer and Osborn 1977)
- c. Proceedings of a Conference on Management of Dredge Islands in North Carolina Estuaries (Parnell and Soots 1975b)
- d. Ecological Succession of Breeding Birds in Relation to Plant Succession on Dredge Islands in North Carolina Estuaries (Soots and Parnell 1975b)
- e. Nesting and Migration Areas of Birds in the U. S. Great Lakes (Scharf 1977)

Small Land Birds

102. A variety of small land birds use dredged material sites--specific use depends on the nature of the available habitat, the time of year, and the region. It is not feasible to discuss the species individually, but some basic generalizations are in order. Generally the small land birds that occupy dredged material sites in a given region will be those birds that occupy similar habitats (i.e., bare ground, grassy fields, thickets, or forests) on nearby natural sites. Local or regional checklists will provide a ready source of species likely to occur in a given location; dredged material sites thus generally become small units of much larger regional habitats. The dredged material sites may become more important to such birds when they serve as refuges for migrants or when they provide small units of vegetation in large expanses of water, in urbanized areas, or in other unsuitable avian habitats. Island sites along the Atlantic and Gulf coasts and perhaps in the Great Lakes become very important resting and feeding sites for birds making long migratory passages. Islands along the Gulf coast, for example, are heavily used by spring migrants that have just completed the long overwater flight across the Gulf of Mexico.

103. Development of terrestrial habitat for mammals or birds will benefit many species of small nongame land birds as well by providing food and cover sources.

Hawks and Owls

104. Dredged material deposition sites may attract a variety of hawks and owls if the small mammals or small birds on which they prey are abundant on or adjacent to the site. As is the case with small land birds, such utilization is generally by species that typically occur in similar habitats on nearby natural sites.

105. Hawk and owl population levels on dredged material sites should generally be expected to be about the same as those in adjacent habitats unless the dredged material sites have especially high prey populations or act as islands of suitable habitat in large expanses of unsuitable habitat. Along the south Atlantic and Gulf coasts utilization by raptors increases greatly during winter when local populations are increased by the addition of migrant species. There is a heavy southward fall migration of many hawk species, especially in October, along the barrier islands and over the dredged material islands of the waterways and also down the major river valleys. Management which provides food and cover for the raptors' prey will be the most beneficial management for the raptors themselves.

Small Mammals

106. A variety of small nongame mammals (mice, rats, moles, shrews, etc.) occur on dredged material sites. This occurrence has been little studied, but populations and species compositions should be similar to nearby natural sites with comparable habitats unless the dredged material sites are islands well isolated from the mainland. Such isolated sites would be expected to have a reduced small mammal diversity. Regional mammal publications should provide an indication of species likely to occur on specific sites. Habitat development efforts to establish food and cover for game mammals or birds will benefit small mammals as well.

Amphibians and Reptiles

107. Amphibians (salamanders, frogs, and toads) and reptiles (crocodilians, turtles, lizards, and snakes) together form the herpetofauna of dredged material areas. As a rule, the numbers and species diversity of amphibian and reptile populations in the United States

decrease with increases in latitude (from south to north), and the nature of the herpetofauna changes drastically from east to west with the corresponding changes in topography and climate.

108. Native herpetofauna generally will be more abundant and diverse on riverine dredged material sites than in coastal or estuarine areas, but they probably will not form major components of the biotic communities on any dredged material sites. The character of a site's herpetofauna will depend on its location in regard to broad zoogeographic regions and on its location in the immediate environment--i.e., whether it is an island or on the mainland.

109. Along the coasts, disposal sites generally are separated from the mainland by saline waters, and such conditions provide effective barriers to most amphibians. In addition, many sites are made of coarse, porous substrates that dry quickly and do not provide the moisture most amphibians need. Frogs and toads will generally be more abundant than salamanders on dredged material sites.

110. Reptiles are better equipped to reach dredged material sites and to survive there than amphibians, and one could expect to encounter turtles and snakes on most sites. Lizards could move onto sites that are contiguous with the mainland, and along the Atlantic and Gulf coasts lizards are sometimes even found on dredged material islands. In the southeastern coastal areas the American alligator (*Alligator mississippiensis*) may use dredged material sites.

111. The field guides to amphibians and reptiles cited earlier (paragraph 67) together cover the United States and can be consulted to determine which species occur in particular areas.

112. Management of dredged material areas specifically for amphibian or reptile species would rarely be justified. Their major role in a developing terrestrial habitat may well lie in their providing food for other animals, since they (or their larval stages in the case of amphibians) are eaten by a variety of birds and mammals.

Threatened and Endangered Species

113. Federal legislation has provided special protection to a number of animal species throughout the United States by designating them as threatened or endangered. In addition, certain populations or subspecies may be designated as threatened or endangered. See the Federal Register, Vol. 42, No. 135 for a complete list of threatened or endangered species and subspecies. In addition to the Federal list, many states have generated lists of threatened or endangered species. The Federal endangered/threatened species list and the lists (official or unofficial) for all 50 states are compiled in Management of Transmission Line Rights of Way for Fish and Wildlife for Evaluation Purposes, a study conducted for the USFWS by Asplundh Environmental Services. This report, presently in draft, will be available in January 1979 (Personal Communication, January 1978, Dr. Kenneth Hoover, National Power Plant Team, USFWS, Ann Arbor, Michigan). References to the sources of these lists are given in Appendix B. These threatened or endangered species should receive special attention wherever management of dredged material sites is contemplated.

114. Several of the Federally designated species are known to use upland dredged material deposition sites. The brown pelican uses dredged material islands along the Atlantic and Gulf coasts as nesting, feeding, and resting sites (Chaney et al. 1977, Parnell et al. 1978, Schreiber and Schreiber 1978). The peregrine falcon (*Falco peregrinus*) is known to use dredged material islands in North Carolina during its fall migratory passage (Parnell et al. 1978) and likely uses such sites along the entire Atlantic and Gulf coasts. In Texas, whooping cranes (*Grus americana*) winter in the coastal estuaries adjacent to the Gulf Intracoastal Waterway in the vicinity of dredged material islands and probably use such islands to some degree. American alligators (*Alligator mississippiensis*) also likely use dredged material areas along the south Atlantic and Gulf coasts and in the lower Mississippi River system.

115. In addition to listing species as Federally threatened or endangered, subspecies or local populations may be so designated.

Examples of endangered subspecies are the California least tern (*Sterna albifrons browni*) which is known to use dredged material sites for nesting, the southern bald eagle (*Haliaeetus leucocephalus leucocephalus*), and the Columbian white-tailed deer (*Odocoileus virginianus leucurus*).

116. The level and manner of utilization of dredged material areas by endangered species other than brown pelicans are generally not well documented. Many of the species on the Federal endangered species list have a recovery team devoted to coordinating efforts for the recovery of the species. When management of one of these species is contemplated, the USFWS should be contacted for reference to the appropriate team.

117. State lists of threatened or endangered species will provide lists of those species that are of special concern within state borders but are not designated as threatened or endangered nationally. Many of these species may be benefited by dredged material site management. State fish and game commissions, natural history museums, or university biology or zoology departments should be able to provide more detailed information on the biology and ecology of locally threatened or endangered species.

PART V: PROPAGATION, ESTABLISHMENT, AND MAINTENANCE PRACTICES

118. The species synopses in Part VI include an Establishment and Maintenance section for each plant species. The plants can be divided into two general groups: (1) woody plants (trees, shrubs, and woody vines) which will normally be propagated at nurseries and then planted on the dredged material site as seedlings or well-rooted cuttings, and (2) annual or biennial herbaceous species which will be seeded directly on the site. The following material is provided to explain the meaning of the various propagation, establishment, and maintenance practices which apply to these groups and to eliminate the need for unnecessary repetition within the synopses.

Plant Selection

119. Plant species to be used for dredged material plantings must be adapted to the climate and to the physical and chemical properties of the dredged material; they must also be suitable for the intended habitat development goal for the site. The plants best fitted for the job will likely be indigenous species. Native species seldom planted for wildlife or uncommon plants with unusual cultural requirements may be good choices for dredged material plantings; however, information about planting techniques and sources of seed or planting stock for such plants may be difficult to find. Technical assistance in solving these problems and in answering questions concerning cultural methods can be obtained from the local county Soil Conservation District and from the District Conservationist of the USDA-SCS. Another excellent information source is the regional SCS Plant Materials Specialist who is responsible for this kind of work in an area of one or more states. These people routinely handle problems involving plant selection, source, establishment, and maintenance. Appendix C lists the addresses of SCS plant materials specialists, plant materials centers, and regional biologists throughout the United States. The local County Agricultural Extension Chairman or Agricultural Experiment Station personnel may provide

agricultural assistance. In addition, state wildlife and forestry departments and other state agencies dealing with environmental subjects also can provide advice and, in some cases, give material assistance.

Seed Treatment

Collection

120. Seeds of woody and herbaceous plants usually can be purchased from commercial dealers. Lists of commercial seed dealers and lists of seeds they carry are published from time to time by the SCS or other USDA agencies or by the USFS. Occasionally it may be expedient to collect seed from local wild plants. Such collections are ideally made from the same general climatic area as the proposed site. Before collection, the viability of the seed must be determined. Hard nutlike seeds may be cracked with a hammer; softer seed coats may be cut with a knife. Small grass seeds can be tested by biting them to feel the kernel inside. In all cases it must be determined if the embryo has fully developed. Green immature seeds with high vegetative debris and moisture content must be spread out to dry. Unless planted in the fall, seeds with hard nut-like seed coats are usually cleaned and stored dry prior to stratification. Softer seeds from many of the fleshy fruits (apple, pear, etc.) must be cleaned and planted immediately or kept moist until planting time.

Scarification

121. Many plants have seeds with hard, moisture-resistant seed coats. This condition, which prevents germination, can be overcome by abrading the seed coats with a seed scarification machine or by hand with sandpaper or by reducing the seed coat surface with sulfuric acid (H_2SO_4). With this latter treatment, the dry seeds are placed in a glass container and thoroughly wetted with concentrated acid. The treatment lasts from 15 to 60 minutes depending on the thickness of the seed coat. Seeds must then be flushed with water before the acid burns through the seed coat. Seeds can be planted immediately while wet or dried and stored for later planting (Schopmeyer 1974).

Stratification

122. The seeds of many woody perennials require a cold, damp period to break dormancy and induce germination. Fall planting will fill this need. If the seeds are to be held over until spring, they must be stratified. This process involves mixing the cleaned seeds with sand, peat, sphagnum, or sifted sawdust in the ratio of three to five parts inert material to one part seed. The mix is then put into plastic bags, boxes, or other containers and refrigerated at 40°F for 30 to 60 days before the expected spring planting date (Figure 1). Seeds of some grasses, such as American beach grass (*Ammophila breviligulata*) and switchgrass (*Panicum virgatum*), benefit from stratification. Grass seeds may be moistened without the addition of an organic material because the husks and chaff of the seeds provide the moisture-holding medium. Stratified seeds must not be allowed to dry out (Schopmeyer 1974).



Figure 1. Pine seeds stratified in damp sphagnum moss. (SCS photo)

Propagation by Cuttings

123. Small quantities of trees, shrubs, and vines can be propagated from stem or root cuttings. As a rule of thumb, evergreen cuttings are usually taken in late summer after the first big flush of new growth has stopped or "hardened off" (Hartmann and Kester 1968). Cuttings of deciduous plants usually are propagated by softwood cuttings using the new spring growth which is ready in early summer. A handy length for cuttings is 4 to 6 in. Leaves on the butt ends are carefully snipped off, leaving two to four leaves at the top end. The more leaves left on the cutting the better the rooting response, provided there is no wilting.

124. Hardwood cuttings of deciduous plants may be taken late in the fall after the leaves have fallen. The cuttings are tied in bundles and buried out of doors upside down in sandy soil, or placed in a refrigerated box of moist sand, sawdust, or peat. The butt ends will callus by spring. They then are removed and planted in greenhouse cutting beds or other containers covered with glass or transparent plastic until the cuttings have become well rooted.

125. The rooting process may be improved by the use of a hormone, available in the form of powder or liquid, applied to the bottom ends of the cuttings. Two commercial products, Hormodin and Rootone, each come in three concentrations; instructions come with each jar (N. C. Wildflower Preservation Society 1977). The rooting medium is sharp sand, peat moss, sphagnum moss, vermiculite, or mixtures of these. A good general mix is three parts sand to one part peat moss. The mix is packed to a 6-in. depth in greenhouse benches or boxes. Holes are punched in the medium with a round stick, and cuttings are inserted two-thirds of their length. The surface of the rooting medium is then flushed with water to drive out all air pockets. Boxes of cuttings must be stored in a greenhouse or covered with a sheet of glass or plastic-- i.e., "under glass." All cuttings covered this way must be protected from direct sunlight; they may, for example, be placed along the north side of a building or under the partial shade of a pine tree canopy.

Field Planting

Dates

126. Planting of all trees, shrubs, woody vines, and the vegetative reproductive parts of some herbaceous plants should take place during the dormant season. Balled or containerized stock is best planted at this time but may be planted on into the summer if it is not allowed to dry out. The best time for planting bare-rooted nursery stock in the more northern states is in the early spring, because such planting during the fall and winter usually results in losses from frost heaving and drying (Iowa Dep. Soil Cons., Land Rehabilitation Advisory Board 1973?).

127. Seedlings of summer-growing herbaceous plants should usually be planted in the spring at the earliest optimum date to take advantage of cooler temperatures and better moisture conditions. Cool season herbaceous plants are normally planted at the earliest optimum date to become established before cold weather. But there are exceptions to the above. In Florida, for example, some warm season crops are planted in July to correspond with the "rainy season." Check with local agricultural agencies for suggested planting dates.

Fertilization

128. A soil test should be made prior to any major field planting. The test will point out what must be done to improve the soil conditions of the site to meet the minimum needs of desired plants. By indicating existing conditions, the test will narrow the selection of plants which can subsist on the site. Usually some native plants can subsist on unimproved sites. Material dredged from saltwater areas will probably be too highly saline initially to grow plants with low salt tolerance. Deep plowing, leaching (over time), and establishment of tolerant vegetation are treatments which will reduce salt content of the sediments. Highly acidic dredged material may need to be neutralized by the addition of lime. Some species, however, will grow on such saline or acidic sites. Again, predetermination of the

presence or absence of certain elements in the soil is needed to make the proper selection of plants.

129. On dredged material areas accessible to farm machinery, large seedings can be fertilized by machine application. On small or less accessible areas, materials may have to be brought in by boat and fertilizer broadcast by hand. In such situations a single-row, hand-propelled fertilizer distributor would be a useful implement. Various seeds can be mixed with regular pelleted fertilizer (e.g., 8-8-8) and all planted simultaneously in the rows opened by the machine (Graetz 1973). The result of planting saltmeadow cordgrass (*Spartina patens*) by this method can be seen in Figure 2.



Figure 2. Saltmeadow cordgrass established in rows by planting a mixture of seed and fertilizer with a single-row fertilizer distributor. (SCS photo)

130. Fertilizer is used sparingly on hand-planted, bare-rooted nursery stock. It is placed in the hole well below the root zone or in slits 6 in. from the stem after the plant has been put into the soil. About 0.5 oz (or rounded tablespoon) of 8-8-8 or 10-10-10 fertilizer is sufficient. These ordinary fertilizers should never be mixed in with the soil around the roots. Some slow-release fertilizer products are

less hazardous to use at planting time. Agriform Plant Tabs and Root-contact Pakets are made to be dropped into the planting hole just below the roots. Osmocote and Mag Amp are two products that can be mixed with the soil packed around the roots (a rounded teaspoon per gal of soil). For extremely sandy, droughty sites, it helps to mix in organic material (sawdust, ground pine bark, peat moss, etc.) or topsoil.

131. If practical, fertilizer is recommended for seedlings and woody-stock transplants both at planting time and later as needed for maintenance; consider known species requirements in determining the amounts of fertilizer to use. Special caution should be used to avoid burning new transplants with the common granulated fertilizers.

Methods

132. The field planting methods employed are determined by the accessibility of a site for farm equipment and by the soil conditions. On large accessible sites, tractor-drawn equipment is the most feasible approach. Not only can tree and shrub seedlings be planted with a tractor-drawn tree planter, but herbaceous material such as American beachgrass culms also can be mechanically planted (Figure 3). Seeding operations also can be handled mechanically. Much dredged material will be newly deposited; such areas are often quite flat and weed free. Thus the usual need to prepare a firm, weed-free seedbed is eliminated.

133. On sites that are inaccessible or unsuitable for machinery, simple hand tools must be used. Consequently the size or number of plantings may be limited. Bare-rooted seedlings, cuttings, or propagules of herbaceous plants must be planted with planting bars or nursery spades (Figure 4). Holes must have sufficient depth so that roots will not be doubled up when planted. It is better to trim off the longest roots rather than to have the ends turned upward in the hole. This is especially important with pine or any other tap-rooted species. Grass sprigs, for example the stems of American beachgrass, are planted in the same manner. After such plantings, the soil must be packed firmly around each plant. In any planting operation with bare-rooted plants, extreme care must be taken not to let the roots dry out. If not unreasonably inconvenient, watering after planting is very



Figure 3. American beachgrass seedlings being planted with a tractor-drawn mechanical planter. (SCS photo)

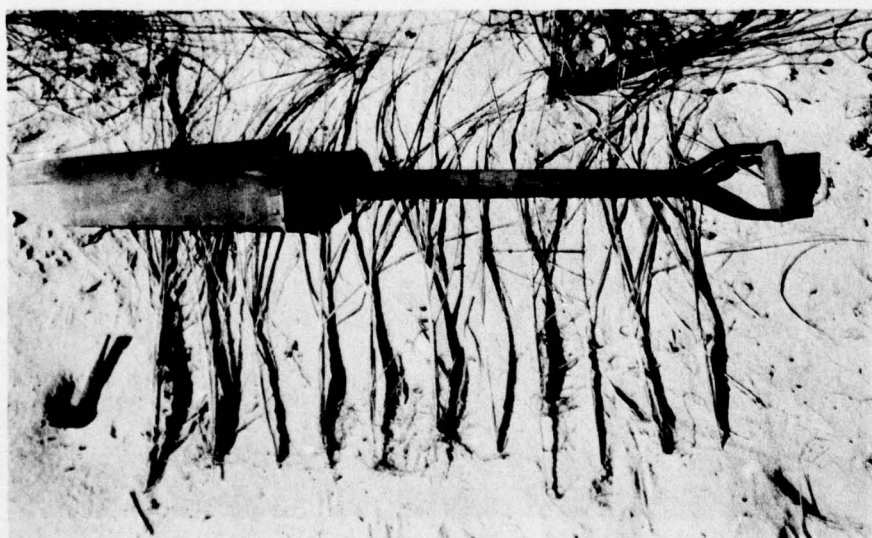


Figure 4. American beachgrass planting stock and the "sharpshooter" spade. (SCS photo)

beneficial. The planting of grass and herb seeds will also be a hand operation on inaccessible sites.

134. Whether sown by machine or by hand, seeds must be covered. In light sand soils, seeding depth is more than twice that on fine-textured soils. The seeds of grasses and herbs can be broadcast with a hand-operated Whirlwind seeder, followed by hand broadcasting lime and fertilizer (if needed) and raking the mixture into the soil. Raking, however, is laborious, does not cover the seeds very well, and does not firm the soil. A solution is to use a single-row hand garden planter. This machine opens a furrow, drops an accurate number of seeds per foot, covers the seeds, and packs the soil, all in one operation. The seed-fertilizer mixture planted with a single row fertilizer distributor (as described in the preceding section) also works well. Unless wind and water erosion conditions are critical, seedings may be made in rows with 2- to 3-ft middles as shown in Figure 5. If site conditions are critical, rows should be closer together.



Figure 5. Grass planted in rows on dredged material. (SCS photo)

135. Preliminary establishment of fast-growing tolerant plants is highly recommended prior to planting herbaceous perennials and woody plants that are not fully adapted to the strong winds and salt sprays characteristic of many dredged disposal sites. Higher rates of survival are assured by emulating the natural succession process whereby pioneer plants colonize a site and prepare it for species with different growth requirements. Preparatory plantings, in addition to providing protective cover from salt spray and sand blast, also improve soil moisture and nutrient conditions and moderate the sand temperatures. As the vegetation decays, plant nutrients are returned to the soil. The plant residues also favor the increase of microorganisms in the soil. Suitable protective plantings are grasses, as shown in Figure 6, or other herbaceous annuals or perennials planted in rows or broadcast, seeded or sprigged. Row plantings 18 to 24 in. apart work especially well on the more erosion-prone sites. The permanent plants, both herbaceous and woody, may later be seeded or transplanted between rows or between plants if seeds were broadcast. Thus the secondary planting has a protective cover but does not compete with the already established plants. As shown in Figure 7, woody nursery stock does well between rows of perennial grass which have been allowed to grow for a full season or more. The advantages of establishing a protective cover of well-adapted, rapidly growing grasses or herbs before investing time and money in permanent plants of less tolerant woody and perennial stock cannot be stressed sufficiently.

136. Another means of providing wind protection and stabilizing moving sand on newly created sites is by use of a sand fence. A slatted fence oriented parallel to the shore in the middle of the area to be planted will aid in accumulating sand while the plants are becoming established (Seltz 1976). Use of a sand fence with a successful American beachgrass planting on a man-made dune is illustrated in Figure 8.

137. The direct seeding of trees, shrubs, and vines on problem sites such as dredged material areas has not been fully explored. Some fall seeding on sand dunes has proved successful for wild bamboo



Figure 6. A protective cover of rye established on dredged material in the fall prior to a spring planting of a more permanent species. (SCS photo)



Figure 7. A test plot of eastern redcedar established in a protective 2-year-old stand of American beachgrass. (SCS photo)

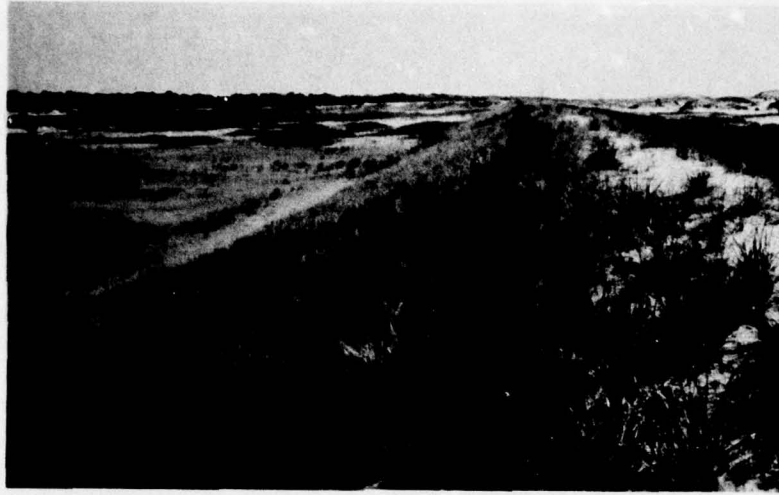


Figure 8. Established 3-year-old stand of American beachgrass with a protective and stabilizing sand fence. (SCS photo)

(*Smilax auriculata*) and live oak (*Quercus virginiana*), as can be seen in Figure 9. Live oak, with its large reserve of plant food in the acorn, was the most dependable, germinating soon after planting; the wild bamboo seed did not germinate until the second spring (Graetz 1973). Both species were slow to grow on sand dunes, but would probably grow faster on most types of dredged material. Direct seeding of woody plants in conjunction with protective nurse crops on dredged material appears to be a promising alternative to using nursery-grown stock. Because of variation in height and lateral growth of various woody perennials, they should not be mixed without examining their growth characteristics.

Maintenance

138. Newly deposited dredged material is generally weed free. Thus, weed competition at planting time may not be a factor, and the usual necessity of cultivation to eliminate fast-growing weeds may be unnecessary. One aspect of long-term maintenance will be to monitor the natural invasion of native weeds and other plants. Some common invading plants are excellent wildlife foods, and desired maintenance may consist of encouraging their increase. In most instances, the field plantings will not be designed for management as intensively cultivated, highly



Figure 9. (Above) Wild bamboo seedlings emerging on dune sand. The seeds did not germinate until the second spring. (Below) Live oak seedlings emerging in the spring from acorns planted the previous fall. (SCS photos)

productive field crops. Fertilizer applications will generally be minimum amounts and will be used mainly during the establishment period. Initial plant selection should favor those plant species which can become established and fulfill the desired habitat development goals while requiring minimal establishment and maintenance efforts.

PART VI: SYNOPSES OF PLANT SPECIES OF VALUE FOR TERRESTRIAL
WILDLIFE HABITAT DEVELOPMENT ON DREDGED MATERIAL

139. Species synopses are presented for 100 species of plants which can be used to develop terrestrial wildlife habitat on dredged material sites within the contiguous United States. In selecting these plants, the CZR study team emphasized plants with food and/or cover value for wildlife and plants which naturally occur on dredged material areas. These indigenous plants are more likely to be successfully established, and the animals commonly found on disposal areas are accustomed to using them for food or cover. Some plants occur throughout the contiguous United States; others occur only in localized regions but were selected due to their value in that region. Some species selected are considered to be obnoxious weeds by agricultural interests. However, these plants are valuable to wildlife and do well under the extreme conditions often typical of dredged material sites. They are recommended for use only on sites isolated from agricultural areas. Various introduced species that have been widely used, tested, and accepted as wildlife plantings and that are potentially useful for wildlife habitat development on dredged material were also selected; these include cultivated grains, such as corn, wheat, barley, and rye, and other nonnative woody or herbaceous plants, such as autumn olive, Russian olive, multiflora rose, Japanese honeysuckle, reseeding soybean, bicolor lespedeza, and sericea lespedeza.

140. Most of the plants selected were chosen for rapid establishment of terrestrial habitat; thus many grasses, herbs, and fast-growing vines and shrubs are listed and relatively few slow-growing trees and shrubs. Many additional species of value to wildlife occur naturally or can be planted on dredged material sites. A list of approximately 250 species (including the 100 for which synopses are given) with potential for terrestrial habitat development is indexed by life form and state in Appendix A.

141. Though it is beyond the scope of this terrestrial habitat development project, some consideration should be given to the many

wetland plants, high in wildlife value, which are suitable for moist or wet habitats on or along the edges of an upland site. Such plants include the bulrushes (*Scirpus* spp.), spikerushes (*Eleocharis* spp.), smartweeds (*Polygonum* spp.), and others. These or other wetland plants may also provide erosion protection. Many dredged material areas are subjected to wave action generated by the wakes of boats or high winds that can cause serious erosion problems along the shoreline. Wetland vegetation planted along the shore will help protect such susceptible areas from damage. For example, in a saltwater situation along the east coast, smooth cordgrass (*Spartina alterniflora*) might be planted at the water's edge just below the high tide line, and saltmeadow cordgrass (*Spartina patens*) a few feet above the high tide line. In a short time such a planting should develop a vegetative buffer to protect adjacent, strictly terrestrial plantings. There are many other suitable wetland species which can be employed as buffers against wind and wave action.

142. The 100 plants selected are listed by life-form (trees, shrubs, vines, herbs, grasses) and indexed by states (within the contiguous United States) in Table 1 (pages 69 through 72), and are indexed by adaptability to extreme soil conditions in Table 2 (pages 73 through 77). For each genus, a short introduction is provided. The purpose of this introduction is to give additional information about the genus as a whole or about other species of the genus besides those selected for the final 100-plant list. The genus introductions follow no specific format.

143. For each plant species, the synopsis includes the scientific name, authority, and common name, along with a range map and illustration. The synopses are presented in the following format:

- a. description and life history,
- b. habitat,
- c. soil requirements,
- d. establishment and maintenance,
- e. disease and insect problems,

- f. wildlife value, and, in some cases,
- g. comments.

144. The illustrations came from a variety of sources that are credited on the final page of this section. Two kinds of range maps are found in the species synopses. Ranges for native and naturalized exotic species are based on distribution information from various state and regional manuals and floras. For regions for which data are incomplete, some assumptions had to be made. The ranges for ornamental and agricultural species which do not typically escape from cultivation are based on the traditional hardiness zones in which the species are capable of growing. The ranges are indicated on the maps as follows:

Native and naturalized species



Ornamental and agricultural species



145. Some of the elements (Description and Life History, Habitat, Soil Requirements) follow standard botanical form. Standard botanical vocabulary was used except for some descriptive terms that were simplified or explained to facilitate understanding by persons with limited botanical background.

146. Available literature references were incomplete for some plant species, especially in the case of pH values; consequently some pH ranges are best estimates based upon study members' personal knowledge of habitat, soil conditions, and general cultural requirements. Likewise, establishment and maintenance procedures were compiled from the best available material; in cases where information was lacking, sources dealing with similar species were consulted. Establishment and maintenance methods and terminology are presented in detail in Part V.

147. Disease and insect problems identified from literature and personal knowledge of study team members are presented for most plant species. Other species were listed as "None", but this does not mean they will always be disease and insect free.

148. Each Wildlife Value section begins with the plant's food and cover values which were subjectively estimated based on available

literature and according to the following definitions:

a. Food Value

High: Plants of high food value are preferred or staple foods used regularly by a variety of wildlife species found on dredged material areas, or they are preferred, heavily used foods of a limited number of important wildlife species. Animals apparently find these plants to be palatable, and they are important nutrient-supplying foods.

Medium: Meeting any of three criteria places a plant in the medium food value category: (1) being a staple food used regularly by an intermediate number of the wildlife species found on dredged material areas, (2) being used to a lesser extent by a few important species, or (3) being used occasionally by a great many kinds of animals.

Low: Plants of low food value are used irregularly, perhaps only in critical seasons or in emergencies, by only a few of the wildlife species found on dredged material islands.

b. Cover Value

High: Used regularly or extensively by a wide range of wildlife or heavily by a more limited number of species of special interest.

Medium: Used regularly by a small to intermediate number of wildlife species or infrequently by a large number of species.

Low: Used infrequently by a small number of wildlife species.

149. A Comments section for general or miscellaneous information may appear following the wildlife value. Notes on potential pest status of the species will be given here, if applicable.

Table 1

*Ornamental or agricultural cultivar potential range based on hardness zone tolerance.

Table 1 (Continued)

[illegible]

*Ornamental or agricultural cultivar potential range based on hardness zone tolerance.

Table 1 (Continued)

Scientific name, common name	NORTHEAST										SOUTHEAST										NORTH CENTRAL										SOUTH CENTRAL										NORTH WEST										SOUTH WEST																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
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<i>Croton capitatus</i> , Woolly croton	X	X			X	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

*Ornamental or agricultural cultivar potential range based on hardiness zone tolerance.

Table 1 (Concluded)

		NORTHEAST										SOUTHEAST										NORTH CENTRAL										SOUTH CENTRAL										NORTHWEST										SOUTHWEST									
		CT	DE	NY	ME	NH	MA	RI	PA	OH	IN	MI	IL	IA	MN	ND	SD	WI	AR	KY	MS	AL	GA	FL	TX	ID	MT	WY	AZ	CA	OR	WA	UT	CO	NEV	NM	LA																								
Scientific name, common name																																																													
<i>Echinochloa crusgalli</i> var. <i>frumentacea</i> , Japanese millet	*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																						
<i>Echinochloa walteri</i> , Walter's millet																																																													
<i>Festuca arundinacea</i> , Tall fescue		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																						
<i>Festuca rubra</i> , Red fescue		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																						
<i>Hordeum vulgare</i> , Barley	*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																						
<i>Lolium multiflorum</i> , Italian ryegrass		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																						
<i>Panicum amarulum</i> , Shoreline panicum		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																						
<i>Panicum clandestinum</i> , Deertongue		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																						
<i>Panicum dichotomiflorum</i> , Fall panicum		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																						
<i>Panicum miliaceum</i> , Proso millet	*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																						
<i>Panicum ramosum</i> , Browntop millet		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																						
<i>Panicum texanum</i> , Texas millet																																																													
<i>Panicum virgatum</i> , Switchgrass		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																						
<i>Paspalum boeianum</i> , Bull paspalum																																																													
<i>Paspalum notatum</i> , Bahia grass	*																																																												
<i>Paspalum vaginatum</i> , Seashore paspalum																																																													
<i>Pennisetum glaucum</i> , Pearl millet	*																																																												
<i>Phalaris arundinacea</i> , Reed canary grass		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																						
<i>Sesale cereale</i> , Rye	*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																						
<i>Setaria italica</i> , Foxtail millet	*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																						
<i>Setaria lutescens</i> , Yellow bristlegrass		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																							
<i>Setaria viridis</i> , Green bristlegrass		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																							
<i>Sorghum vulgare</i> , Sorghum (milo)	*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																						
<i>Spartina patens</i> , Saltmeadow cordgrass		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																							
<i>Triticum aestivum</i> , Wheat	*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																						
<i>Zea mays</i> , Corn	*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																						

*Ornamental or agricultural cultivar potential range based on hardness zone tolerance.

Table 2
Extreme Soil Conditions Tolerated by the 100 Plants
Selected for Terrestrial Wildlife Habitat*

Scientific name, Common name	Extreme Soil Conditions					
	Sands	Low Fertility	High Salt Content	Low pH (≤ 4.6)	High pH (≥ 7.5)	Extremely Moist Extremely Dry
TREES						
<i>Celtis laevigata</i> , Sugar hackberry	X	X	X		X	X
<i>Juniperus virginiana</i> , Eastern redcedar	X	X	X		X	X
<i>Pinus contorta</i> , Shore pine	X					X
<i>Pinus taeda</i> , Loblolly pine		X		X		
<i>Prunus serotina</i> , Black cherry	X	X	X	X		
<i>Quercus virginiana</i> , Live oak	X	X	X			X
SHRUBS						
<i>Amelanchier canadensis</i> , Canadian serviceberry		X		X		X
<i>Atriplex canescens</i> , Wingscale	X		X		X	X
<i>Callicarpa americana</i> , Beautyberry		X	X			
<i>Cornus stolonifera</i> , Redstem dogwood				X		X
<i>Elaeagnus angustifolia</i> , Russian olive		X	X		X	X
<i>Elaeagnus pungens</i> , Thorny elaeagnus	X	X	X		X	X
<i>Elaeagnus umbellata</i> , Autumn olive		X				X
<i>Ilex verticillata</i> , Winterberry		X		X		X
<i>Ilex vomitoria</i> , Yaupon	X	X	X		X	
<i>Lespedeza bicolor</i> , Shrub lespedeza	X	X		X		
<i>Myrica californica</i> , Pacific wax myrtle	X		X			X
<i>Myrica cerifera</i> , Wax myrtle	X		X	X	X	
<i>Myrica pensylvanica</i> , Bayberry	X		X		X	X

Table 2 (Continued)

Scientific name, Common name	Extreme Soil Conditions					
	Sands	Low Fertility	High Salt Content	Low pH (≤ 4.6)	High pH (≥ 7.5)	Extremely Moist Extremely Dry
<i>Prosopis juliflora</i> , Honey mesquite	X	X			X	X
<i>Prunus virginiana</i> , Common chokecherry	X				X	X
<i>Rhamnus purshiana</i> , Cascara buckthorn	X				X	
<i>Rhus copallina</i> , Dwarf sumac	X	X		X		X
<i>Rhus glabra</i> , Smooth sumac		X		X		
<i>Rosa carolina</i> , Carolina rose		X		X		X
<i>Rosa multiflora</i> , Multiflora rose					X	
<i>Rubus allegheniensis</i> , Allegheny blackberry				X		
<i>Rubus argutus</i> , Sharp-toothed blackberry		X				
<i>Rubus cuneifolius</i> , Sand blackberry	X			X		
<i>Rubus spectabilis</i> , Salmonberry						
<i>Salix hookeriana</i> , Hooker's willow						X
<i>Salix interior</i> , Sandbar willow	X					X
<i>Sambucus caerulea</i> , Blue elderberry					X	
<i>Sambucus canadensis</i> , American elderberry						X
<i>Vaccinium corymbosum</i> , Highbush blueberry	X			X		X
<i>Vaccinium ovatum</i> , Western huckleberry	X			X		X
VINES						
<i>Lonicera japonica</i> , Japanese honeysuckle					X	
<i>Parthenocissus quinquefolia</i> , Virginia creeper	X			X	X	
<i>Smilax auriculata</i> , Wild bamboo	X	X	X		X	X
<i>Smilax bona-nox</i> , Fringed catbrier	X			X		
<i>Smilax glauca</i> , Sawbrier	X	X		X		X

Table 2 (Continued)

Scientific name, Common name	Extreme Soil Conditions					
	Sands	Low Fertility	High Salt Content	Low pH (≤ 4.6)	High pH (≥ 7.5)	Extremely Moist Extremely Dry
<i>Smilax rotundifolia</i> , Common greenbrier	X	X				
<i>Vitis aestivalis</i> , Summer grape	X		X	X		X
<i>Vitis riparia</i> , Riverbank grape					X	
<i>Vitis rotundifolia</i> , Muscadine grape	X	X	X	X		X
<i>Vitis vulpina</i> , Frost grape					X	
HERBS						
<i>Amaranthus retroflexus</i> , Redroot pigweed				X		
<i>Ambrosia artemisiifolia</i> , Common ragweed	X			X		
<i>Ambrosia psilostachya</i> , Western ragweed				X		X
<i>Chenopodium album</i> , Common lambsquarters				X	X	
<i>Croton capitatus</i> , Woolly croton		X				
<i>Croton glandulosus</i> , Tropic croton		X				
<i>Cyperus esculentus</i> , Chufa	X			X		
<i>Erodium cicutarium</i> , Common filaree	X					
<i>Glycine ussuriensis</i> , Reseeding soybean				X		
<i>Helianthus maximiliani</i> , Maximilian's sunflower				X		
<i>Lathyrus palustris</i> , Marsh pea	X			X	X	
<i>Lathyrus sylvestris</i> , Flat pea	X					X
<i>Lespedeza cuneata</i> , Sericea lespedeza	X	X		X	X	
<i>Medicago lupulina</i> , Black medick	X			X		
<i>Phytolacca americana</i> , Pokeberry						
<i>Polygonum convolvulus</i> , Wild buckwheat				X		

Table 2 (continued)

Scientific name, Common name	Extreme Soil Conditions					
	Sands	Low Fertility	High Salt Content	Low pH (≤ 4.6)	High pH (≥ 7.5)	Extremely Moist Extremely Dry
<i>Polygonum pensylvanicum</i> , Pennsylvania smartweed					X	X
<i>Rumex acetosella</i> , Sheepsorrel		X		X	X	
<i>Sesbania exaltata</i> , Hemp sesbania						X
<i>Strophostyles helvola</i> , Trailing wild bean	X	X	X		X	X
<i>Trifolium pratense</i> , Red clover					X	
<i>Trifolium repens</i> , White clover					X	
GRASSES						
<i>Ammophila arenaria</i> , European beachgrass	X	X	X		X	X
<i>Ammophila breviligulata</i> , American beachgrass	X	X	X		X	X
<i>Avena sativa</i> , Oats				X	X	
<i>Digitaria ischaemum</i> , Smooth crabgrass					X	
<i>Digitaria sanguinalis</i> , Large crabgrass					X	
<i>Echinochloa crusgalli</i> , Barnyard grass				X		X
<i>Echinochloa crusgalli</i> var. <i>frumentacea</i> , Japanese millet				X		X
<i>Echinochloa walteri</i> , Walter's millet			X		X	X
<i>Festuca arundinacea</i> , Tall fescue					X	
<i>Festuca rubra</i> , Red fescue	X				X	
<i>Hordeum vulgare</i> , Barley					X	
<i>Lolium multiflorum</i> , Italian ryegrass					X	X
<i>Panicum amarulum</i> , Shoredune panicum	X	X	X		X	X
<i>Panicum clandestinum</i> , Deertongue		X		X		X

Table 2 (Concluded)

Scientific name, Common name	Extreme Soil Conditions					
	Sands	Low Fertility	High Salt Content	Low pH (≤ 4.6)	High pH (≥ 7.5)	Extremely Moist Extremely Dry
<i>Panicum dichotomiflorum</i> , Fall panicum					X	
<i>Panicum miliaceum</i> , Proso millet						
<i>Panicum ramosum</i> , Browntop millet	X				X	
<i>Panicum texanum</i> , Texas millet	X	X			X	
<i>Panicum virgatum</i> , Switchgrass	X		X		X	X
<i>Paspalum boscianum</i> , Bull paspalum	X				X	X
<i>Paspalum notatum</i> , Bahia grass		X			X	
<i>Paspalum vaginatum</i> , Seashore paspalum	X		X		X	X
<i>Pennisetum glaucum</i> , Pearl millet	X				X	X
<i>Phalaris arundinacea</i> , Reed canary grass	X				X	X
<i>Secale cereale</i> , Rye	X				X	
<i>Setaria italica</i> , Foxtail millet					X	X
<i>Setaria lutescens</i> , Yellow bristlegrass						
<i>Setaria viridis</i> , Green bristlegrass						
<i>Sorghum vulgare</i> , Sorghum (milo)			X		X	X
<i>Spartina patens</i> , Saltmeadow cordgrass	X	X	X		X	X
<i>Triticum aestivum</i> , Wheat					X	
<i>Zea mays</i> , Corn					X	

*An X in a column indicates the species will generally tolerate that extreme soil condition, although tolerance levels may vary under different environmental and soil conditions. The absence of an X means the species is not recommended for that extreme soil condition because either it will not tolerate the condition or information on its tolerance is not available.

Trees

150. Genus *Celtis*, hackberries. Of the seven species of native hackberry in the United States, five are trees and two are shrubs. Though most frequently found in the eastern and central regions in habitats ranging from rich bottomland forests to limestone hills and coastal sands, hackberries are of greatest value to wildlife in the West. Several of the tree species have been cultivated for many years as shade trees. The tree hackberries frequently have witches-broom (a profusion of twigs at the tips of branches), and mistletoe is particularly abundant in hackberries in the West. Neither of these conditions adversely affects the hackberries' wildlife or ornamental value (Martin et al. 1951, Fowells 1965).

151. The sugar hackberry (*Celtis laevigata*), occurring primarily in the Southeast, is discussed below. Other species may also be suitable for establishment on dredged material sites. For example, the common hackberry (*Celtis occidentalis*) with a more northerly range is an adaptable species found in bottomlands, on limestone soils, on outcrops, and on some dredged material areas.

152. *Celtis laevigata* Willdenow, sugar hackberry. (Figure 10)

a. Description and Life History. A deciduous tree with a spreading round-topped crown to 100 ft, but sometimes shrubby in habit. The bark is distinctive because of the warty or corky ridges scattered on the smooth, light-gray bark. The yellowish-green leaves, 2 to 4 in. long, are narrowly lanceolate or ovate, long pointed at the apex; the margins may be toothed or entire. Minute unisexual and bisexual flowers appear on the same tree from mid-March to May with the leaves. Late spring frosts occasionally kill the flowers and thus reduce fruit formation. In late summer and autumn the orange-red to black spherical fruits, called drupes, ripen. These drupes, which persist into winter, have a firm outer layer and thin, dry, sweetish, edible pulp surrounding the rounded seed or stone. Fruits are not produced until trees are about 15 years old. It is a rapid grower. Trees are sometimes stunted in appearance due to partial burial by deposition of dredged material or wind-blown sand.

b. Habitat. Full sun to full shade; alluvial forests, stream banks.

c. Soil Requirements. Wet to well drained; pH 5.5 to 8.0; calcareous soils, beach sands with coarse shells to rich loam and clay.

d. Establishment and Maintenance. If the fruit is well dried, it is not necessary to remove the pulp from the seeds prior to fall planting or storage. Seeds are stored in sealed containers at 35°

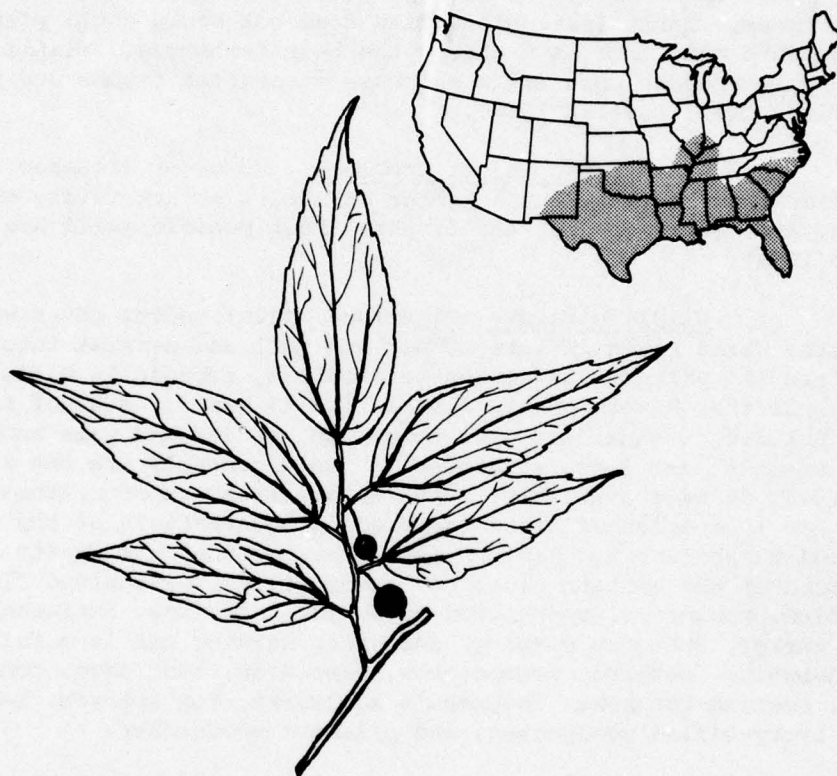


Figure 10. *Celtis laevigata*, sugar hackberry. Twig with leaves and fruit x 0.6.

to 50°F. Prior to spring planting, seeds are stratified in moist sand for 60 to 90 days at 41°F. Fruits with macerated pulps respond more evenly to stratification than those which have not been macerated. For both fall and spring plantings, seeds are sown densely in rows 8 to 10 in. apart. Fall plantings are mulched with straw or leaves and covered with wire screens to protect seeds from rodents and birds. Beds are kept moist until seeds germinate.

Sugar hackberry is also propagated by cuttings taken from vigorous trees. Since fruit production does not begin until plants are about 15 years old, this is probably the best technique. Plantings in the open will produce more fruit and have straighter trunks and many limbs (Vines 1960, Fowells 1965).

e. Disease and Insect Problems. No major diseases or pests attack hackberries; but a number of scales attack twigs, small branches, and, occasionally, the trunks. Leaf petiole galls are common (Fowells 1965).

f. Wildlife Value. High food value; medium cover value. The fruits, which ripen in late summer and fall and persist into the winter, are the primary attraction to wildlife, especially birds. For the genus *Celtis*, Martin et al. (1951) list 48 users. Most of these users, including 6 game birds, 28 songbirds, 10 fur and game mammals, 2 small mammals, and 2 hoofed browsers, would probably use the sugar hackberry if it were available. Van Dersal (1938) reports stomach records for 10 species of birds and feeding observations of the wild turkey and marsh rabbit. Davison (1967) states that the fruits are a choice food of the eastern bluebird, cardinal, yellow-shafted flicker, mockingbird, robin, yellow-bellied sapsucker, starling, Swainson's thrush, turkey, Bohemian waxwing, and cedar waxwing and is a fair food of the bobwhite, catbird, common crow, fish crow, rock dove, common grackle, evening grosbeak, Townsend's solitaire, fox sparrow, hermit thrush, ivory-billed woodpecker, and pileated woodpecker.

The trees provide escape cover and nesting, perching, resting, and roosting sites for birds.

g. Comments. Some authorities recognize local variations of sugar hackberry as varieties. Consequently, taxonomic confusion exists in the delineation of sugar hackberry distribution.

153. Genus *Juniperus*, cedars, junipers. The genus *Juniperus*, composed of evergreen trees and shrubs, is important to wildlife throughout the country, except in the prairies. The berry-like fruits are the main attraction for wildlife, but the cedars and junipers are also important browse and cover plants (Martin et al. 1951). These plants are important because of their ability to grow on dry barren slopes and exposed situations (Van Dersal 1938). The eastern redcedar (*Juniperus virginiana*), the most abundant and widespread species in the East, is discussed below. Other *Juniperus* species may be suitable for dredged material establishment in other parts of the country.

154. *Juniperus virginiana* L., eastern redcedar. (Figure 11)

a. Description and Life History. An evergreen dioecious tree to 30 ft, pyramidal and sometimes columnar in form. In areas exposed to salt wind, it is reduced to shrub form. It has both short, prickly, immature needles and mature softer scale-like foliage. Foliage is dark green to bluish green. The bark is gray and light brown, stringy, and fibrous. In the fall the small globular, blue-green fruits appear on the female plants. Redcedar has only medium resistance to salt spray. It is drought resistant but cannot stand flooding.

b. Habitat. Full sun to partial shade; old fields, hedgerows, fences, woods, dry hillsides, dunes.

c. Soil Requirements. Moist, well drained, dry; pH 5.5 to 7.6; thin rocky limestone soils and shell dune sands to deep fine-textured clay, loam, and silt soils.

d. Establishment and Maintenance. Many commercial nurseries and state forestry nurseries produce seedlings for sale. If seedlings are not available, seeds can be collected in the fall, cleaned, and immediately stratified at 40°F until planted in early spring. Or, the cleaned seeds can be planted and mulched in the fall.

Redcedar is remarkably well adapted to poor, adverse soil situations. Its presence on the almost pure sand of coastal dunes demonstrates this. The 1-year-old, nursery-grown seedlings usually used in revegetation work transplant well during the dormant season, and they are commonly planted between rows of established grass. In coastal dune tests redcedar showed the highest survival rate of 16 species tested (Graetz 1973).

Eastern redcedar is a useful plant to intersperse among low-growing plant species to provide a diversity of food and cover types and thus increase the attractiveness of the site for wildlife. Informal groupings of redcedars are preferable to block plantings. Space the

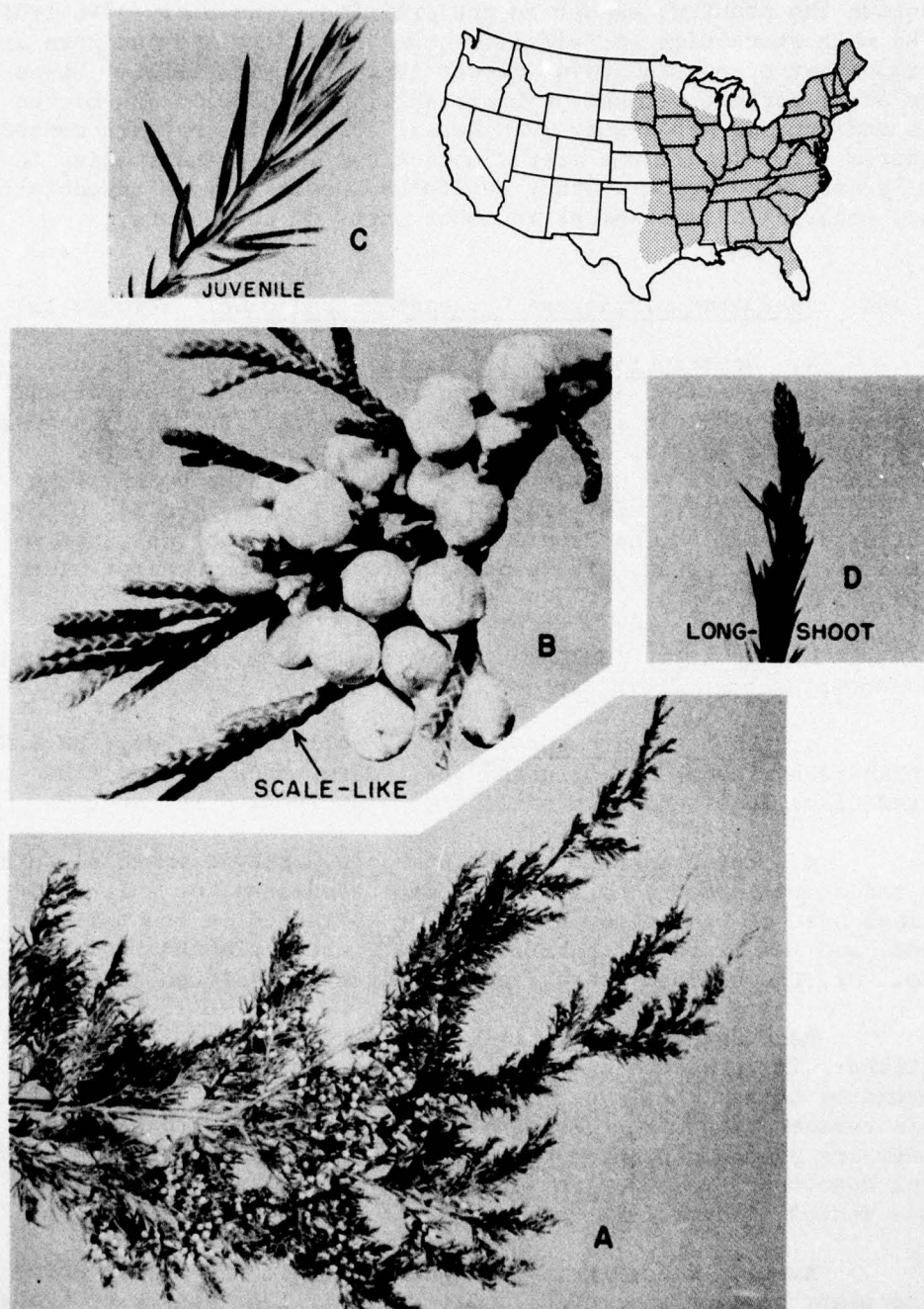


Figure 11. *Juniperus virginiana*, eastern redcedar. A, branch with fruits; B, scale-like leaves; C, juvenile leaves; D, long-shoot of new growth.

plants 8 to 12 ft apart. Once established redcedar requires little care since it can subsist on poor sites. However, its normal slow growth can be increased with spot fertilization.

e. Disease and Insect Problems. This species is an alternate host to a gall-like rust which attacks the leaves of apple trees. For this reason redcedar should not be planted near apple orchards. The galls usually do little damage to the redcedar unless the infections are numerous on small trees. First year seedlings (usually in nursery beds) are sometimes severely damaged by the fungus *Phomopsis juniperivora*. The N. C. Division of Forestry found that nursery seedlings from seed gathered in the coastal area escaped this infection (Personal Communication, Moody Clemmons, Nursery Manager, N. C. Div. of Forestry, Clayton). The suggested control is spraying with Benlate at 2- to 3-week intervals. Bagworms and spidermites sometimes infect redcedar; both can be easily controlled with a suitable spray.

f. Wildlife Value. High food and cover value. The dark blue, berry-like fruit is persistent year-round and is eaten by a variety of birds and mammals. Van Dersal (1938) records the fruits in stomachs of the opossum and 29 species of birds; he also records feeding observations of cottontail rabbits, moose, and 52 species of birds (including bobwhite, sharp-tailed grouse, ring-necked pheasant, and mourning dove). Davison (1967) states that the fruit is a choice food of the eastern bluebird, purple finch, evening grosbeak, pine grosbeak, mockingbird, robin, Townsend's solitaire, myrtle warbler, cedar waxwing, Bohemian waxwing, and that it is a fair food of the cardinal, catbird, white-winged crossbill, common crow, fish crow, yellow-shafted flicker, Traill's flycatcher, ruffed grouse, yellow-bellied sapsucker, fox sparrow, starling, tree swallow, brown thrasher, and hermit thrush. The fruits are also eaten by foxes, raccoons, skunks, and coyotes, and the foliage and twigs are eaten by deer. Although a relatively poor deer food, its foliage is important when other green plants are scarce (Crawford 1961, Ferguson and Lawson 1974). Large numbers of insect-eating birds glean among its twigs and evergreen leaves.

The dense evergreen foliage of redcedar provides excellent protective and nesting cover. It is especially good winter roosting cover for many small birds, such as juncos, myrtle warblers, robins, cedar waxwings, and various sparrows, and for owls, such as the barn owl and short-eared owl. Nests of gray squirrels and various birds are often lined with bark stripped from the trees.

g. Comments. The wood of redcedar is very durable; the heartwood is a distinctive reddish-violet, and the resin is fragrant. In certain areas of the United States redcedar has been decimated by lumbering; young trees are often cut for Christmas trees and for fence posts. The southeastern coastal form (considered by some taxonomists as a separate species, *Juniperus silicicola*) was extensively harvested in the early 1900's as a source of wood for pencils. Redcedar has

little tolerance to fires, but it can survive as an understory plant in deciduous and sometimes evergreen forests. Soils derived from limestone support thick stands of redcedar, and along the Atlantic seaboard this species often invades dredged material which contains copious shell fragments.

155. Genus *Pinus*, pines. Pines are considered by Martin et al. (1951) to be the second most important plant group for American wildlife; they are important as both food and cover. Only the oaks (genus *Quercus*) are more important. Approximately 36 species of pines occur in diverse habitats throughout the United States. The two species listed below were selected based largely on their known occurrence on and adaptability to dredged material sites. However, other species may also be suitable in some instances. For example, white pine (*Pinus strobus*) may be suitable for sites in the Northeast, slash pine (*Pinus elliotii*) in the Southeast, and Monterey pine (*Pinus radiata*) for the southern Pacific coast.

156. *Pinus contorta* var. *contorta* Douglas ex Loudon, shore pine.
(Figure 12)

a. Description and Life History. A variable, scrubby evergreen tree attaining a height of 20 to 40 ft on coastal dunes and interdunal depressions. Shore pine has a rounded crown; the stem is straight when young, but gnarled at maturity. Bark is dark brown to grayish black; deep green needles are in fascicles of two, 1.2 to 2.5 in. long. The female cones mature the second year, are 1.5 to 2.4 in. long, perpendicular to the twig or slightly recurved, and usually remain tightly closed until opened by heat from fire. Cones are asymmetrical and usually persist on the branches. Shore pine is a prolific seed producer with cones often forming on trees 5 to 10 years old. Germination percentage is high. Trees which have been killed by insects or fire may stand for 20 or more years. Shore pines on coarse textured soils or on soils with shallow impermeable layers are susceptible to windfall.

b. Habitat. Full sun; coastal dunes, burned-over areas, other open disturbed areas.

c. Soil Requirements. Saturated, poorly drained bogs, well drained to dry; pH 5.5 to 6.8; gravelly soils, dune sands with little or no clay.

d. Establishment and Maintenance. Optimum germination temperature is inversely correlated with seed source elevation--the higher the optimum germination temperature, the lower the seed source elevation. Stratification during winter improves germination. Under normal conditions seeds germinate in the spring following fall dispersal. Fluctuating temperatures between 47° and 78°F improve germination, but this species often regenerates too abundantly. The tendency toward overstocking and stagnation is probably the most extreme of any species on the North American continent (Fowells 1965). In view of this, seedling stock is probably preferable to broadcasting seeds on dredged material sites. The density of seedlings partially regulates the height of the stand; thus, the planting regime can be modified to

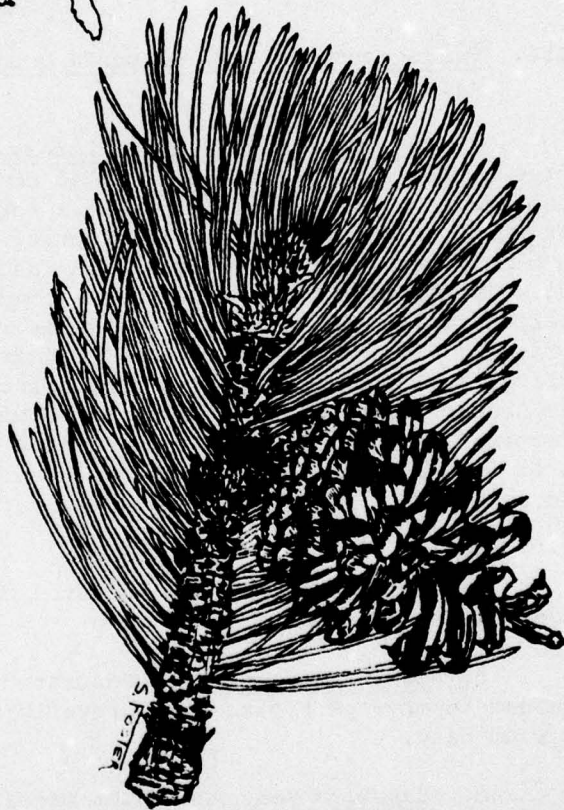


Figure 12. *Pinus contorta*, shore pine. Branch with mature cone x 1.

yield the desired stand growth. Dense stands with abundant leaf litter are susceptible to fire mortality. Mixed plantings of shore pine and various shrubs and understory species, such as Pacific waxmyrtle (*Myrica californica*), western huckleberry (*Vaccinium ovatum*), and salmonberry (*Rubus spectabilis*), are highly recommended. Suggested spacing of such plantings is 8 ft by 8 ft (Brown and Hafenrichter 1962).

e. Disease and Insect Problems. The most serious insect pest of shore pine is the mountain pine beetle. The lodgepole pine beetle also is responsible for tree mortality. Fungal spores are also introduced by the pine bark beetles. The lodgepole terminal weevil attacks the terminal shoots and causes distorted or forked trees. Defoliating insects are the lodgepole needle miner, the lodgepole sawfly, and the spruce budworm. A species of dwarf mistletoe also occurs in shore pine stands. Stem rusts, heart rot, and root rot fungi also cause tree mortality. Though shore pine is susceptible to a variety of diseases and insect pests, "it is ideally suited for semi-permanent stabilization on moderate and well-drained sites on the dunes. It is easy to establish in intermediate plantings of shrubs. The growth rate is phenomenal, averaging 2 ft per year." (Brown and Hafenrichter 1962).

f. Wildlife Value. Food value not documented, but medium value is probable; high cover value. No specific reference of bird use was noted; however, a variety of birds likely use the seeds and glean insects and spiders from the bark and foliage. Plant is of slight importance as browse for mule deer (Van Dersal 1938).

Martin et al. (1951) state that in general pines are valuable as cover for wildlife. They indicate that young trees with foliage spreading near the ground make good year-round cover for gamebirds, furbearers, hoofed browsers, and ground animals; that larger trees are favorite roosting and nesting sites for birds; and that needles are used as nesting material by some songbirds.

157. *Pinus taeda* L., loblolly pine. (Figure 13)

a. Description and Life History. A large, evergreen, monoecious tree. The young trees are conical, gradually losing lower branches to form a rounded crown at maturity. Bark of the tree is reddish brown and grooved with irregular, broad, exfoliating plates. The needles are three per bundle, 4 to 10 in. long, usually 6 to 9 in., and on mature trees they are more or less clustered on the terminal 6 to 10 in. of the twigs. The seed-bearing cones are mostly sessile, 4 to 5 in. long, occasionally smaller on trees growing in stressed habitats. Viable seeds are produced when trees are about 10 years old. Pollen is shed in the spring, and the winged seeds dislodge (from the second-year cones) from October through December.

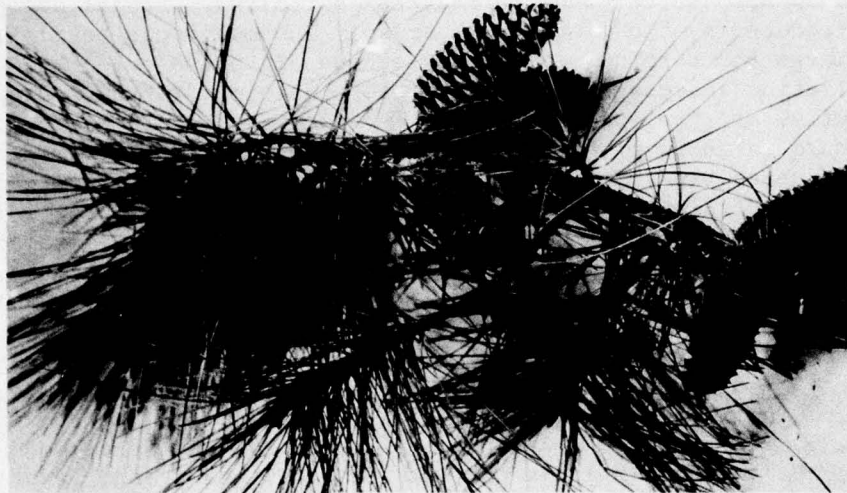
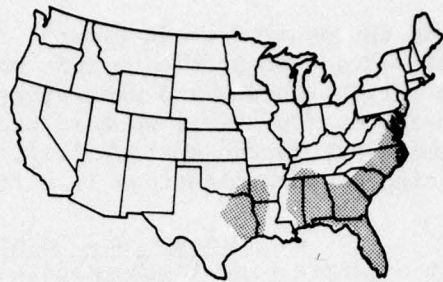


Figure 13. *Pinus taeda*, loblolly pine. A, branch with needles and cones; B, pine seeds.

b. Habitat. Full sun; abandoned fields and disturbed soils, frequently found on islands and hummocks in coastal marshes or on dredged material.

c. Soil Requirements. Poorly drained, moist to dry; pH 5.0 to 6.5; sands, loams, or clays but grows best in soils with poor surface drainage, a deep surface layer, and a firm subsoil (Fowells 1965).

d. Establishment and Maintenance. Seedlings are available from commercial and forest service nurseries. They are usually planted with 6 ft by 7 ft spacing using a tobacco row planter or similar machinery; they can be hand planted by shovel, peg, or other simple device. If the area is prone to flooding, site preparation may be required; use a single or double disc turning plow to form planting rows. Viability is high, and plants, though they may appear weak and spindly, should not be set in multiples.

e. Disease and Insect Problems. Susceptible to attack by the southern pine beetle, loblolly pine stands in scattered areas from Texas to Virginia have been ravaged. Infestation seems to be accelerated by hot, dry weather in late summer and fall and by the presence of injured and weak trees. Removal and burning of the infested trees and debris or spraying with a benzene hexachloride-fuel oil mixture are two accepted practices for small-scale control. Other pests of loblolly pine stands include ingravener beetle, black turpentine beetles, and heart rot.

f. Wildlife Value. Medium to high food value; high cover value. Loblolly pine is one of the more important trees on dredged material areas in the Southeast and adds significant habitat diversity. Davison (1967) states that the seeds are a choice food of the red-winged blackbird, bobwhite, cardinal, Carolina chickadee, mourning dove, rock dove, purple finch, American goldfinch, evening grosbeak, slate-colored junco, brown-headed nuthatch, white-throated sparrow, tufted titmouse, towhee, and wild turkey and are a fair food of the pine warbler. Van Dersal (1938) records the seeds in stomach records of eight species of birds, including the bobwhite. Many other bird species also use the seeds. Species such as the pine warbler, brown-headed nuthatch, titmouse, brown creeper, Carolina wren, eastern bluebird, downy hermit thrush, golden-crowned kinglet, and ruby-crowned kinglet forage in winter in loose flocks on dormant stages of insects and spiders on the bark and among the needles. Gray squirrels, white-footed mice, and other small rodents eat the seeds. Beavers and eastern cottontails sometimes feed on the bark. White-tailed deer occasionally browse the foliage, but this use is minor.

Martin et al. (1951) state that pines are valuable as cover for wildlife. They indicate that young trees with foliage spreading near the ground make good year-round cover for gamebirds, furbearers,

hoofed browsers, and other ground animals. Larger trees are favorite roosting and nesting sites for birds, and the needles are used as nesting material by some songbirds.

g. Comments. Loblolly pine is the most important commercial pine in the South and hence widely planted.

158. Genus *Prunus*, cherries, plums, and others. The genus *Prunus* encompasses more than 400 species and an undetermined number of horticultural strains of small trees and shrubs found naturally in the temperate zones of the world. Plums, peaches, nectarines, cherries, and almonds are contained in this genus; the various cherries and some plums are the most widely used by wildlife. Cultivated cherries often become naturalized, supplementing the availability of native species. Cherry, plum, and peach orchards are often frequented by wildlife. In selecting stock for dredged material habitat development, the locally common species may be much more successful than species that have proved useful elsewhere.

159. *Prunus serotina* Ehrhart, black cherry. (Figure 14)

a. Description and Life History. A large deciduous tree up to 60 ft or more in favorable locations, but usually 10 to 25 ft on poor sites. The oval-oblong, pointed leaves are 2 to 5 in. long, 1 to 2 in. broad, and pointed with finely toothed margins. An orange to brown pubescence is often found on the underside along the midrib. Racemes of small white flowers bloom in the early spring, and the fruit matures in late summer and fall. Fruits are 0.33 to 0.5 in. in diameter, thin skinned, black, juicy, and bittersweet. The bark is reddish brown or gray, striped horizontally with lenticels; it is smooth when young but broken into small plates later.

The tree is a moderately fast grower but takes 8 to 10 years before fruit is produced. The leaves have fair salt wind resistance.

b. Habitat. Full sun; old fields, roadsides, hedgerows, dunes, sand hills.

c. Soil Requirements. Moist, well drained to dry; pH 5.0 to 7.0; sand, sandy soils to fine-textured loams, clay.

d. Establishment and Maintenance. Black cherry is usually propagated by planting the cleaned seeds in fall. Stratified seeds may also be planted in the spring. Stratification period is 90 to 120 days at 41°F. About 24 seeds are planted per linear foot of row and covered 0.5 in. deep. Seedlings may be planted in groups on the higher and dryer spoil sites. A spacing of 8 to 12 ft is left between plants. Tests to determine the feasibility of direct seeding in a grass protective cover should be explored, since nursery stock is usually difficult to secure.

This tree is widely adapted to a variety of soils from high to very low fertility. Once established, maintenance will be low to none.

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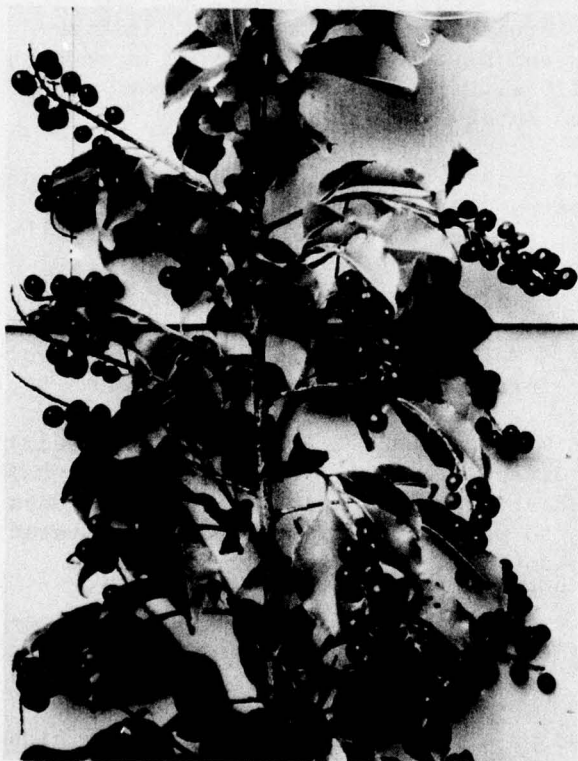
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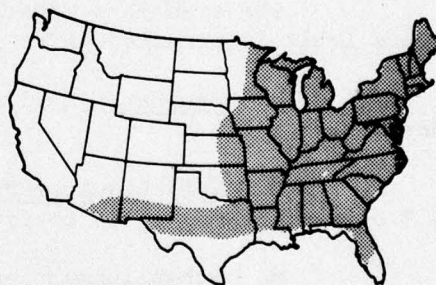


Figure 14. *Prunus serotina*, black cherry. A, flowering branch; B, fruiting branch. (SCS photos)

e. Disease and Insect Problems. The two fungi which most often attack black cherry can be controlled with any good fungicide. Powdery mildew may be controlled with Benlate. Frequent infestations by tent caterpillars are easy to control by hand or with Sevin or Malathion, but are a significant disadvantage.

f. Wildlife Value. High food value; medium cover value. This plant occurs naturally on some dredged material areas. Wild cherries are among the most important wildlife food plants. Many songbirds and important game birds eat the fruits (Martin et al. 1951). Davison (1967) states that the fruit is a choice food of the eastern bluebird, bobwhite, cardinal, catbird, common crow, yellow-shafted flicker, evening grosbeak, rose-breasted grosbeak, ruffed grouse, blue jay, eastern kingbird, mockingbird, Baltimore oriole, orchard oriole, American robin, yellow-bellied sapsucker, white-throated sparrow, starling, summer tanager, brown thrasher, gray-cheeked thrush, hermit thrush, Swainson's thrush, wood thrush, veery, red-eyed vireo, warbling vireo, cedar waxwing, downy woodpecker, hairy woodpecker, pileated woodpecker, red-bellied woodpecker, and red-headed woodpecker and is a fair food of the red-winged blackbird, great crested flycatcher, common grackle, sharp-tailed grouse, ring-necked pheasant, greater prairie chicken, rufous-sided towhee, and wild turkey. Van Dersal (1938) reports that the fruits were found in stomachs of 33 bird species, including ruffed grouse, bobwhite, sharp-tailed grouse, and prairie chicken, and that feeding observations were made of 21 bird species including the bobwhite and ring-necked pheasant. The fruits also are relished by fur and game mammals, such as foxes, squirrels, raccoons, skunks, and black bear, and by small mammals, such as the eastern chipmunk, deer mouse, and white-footed mouse (Martin et al. 1951). Black cherry is a significant browse species for white-tailed deer and is also eaten by cottontails and beaver.

This deciduous tree provides some nesting and protective cover for birds, primarily when leaves are present during the growing season.

160. Genus Quercus, oaks. Oaks are the most important woody plant group to wildlife. The genus is comprised of major forest trees, small trees and shrubs, and small groundcover shrubs that form dense clones by underground runners. The fruits of oaks are nuts, commonly call acorns and are a staple food for some of the most popular wildlife species. Maturation of the acorns is a convenient character for separating the oaks into two major groups: (1) the white oak section in which the acorns mature during one growing season, and (2) the red oak section in which the acorns mature over a period of two consecutive growing seasons (Kurz and Godfrey 1976). Oak species often hybridize and are difficult to identify and classify. Some species are entirely evergreen, some partly evergreen, and some deciduous. Oaks are generally 15 years old before they bear acorns. Many dredged material areas would receive additional deposits prior to oaks' maturation, making the use of oaks less feasible for wildlife habitat development on such areas. Only one species, the live oak (*Quercus virginiana*), which occurs naturally as a dominant on some dredged material areas in the Southeast, is discussed below. Other oaks may also be excellent choices if the sites are planned for long-term wildlife management with no future dredged material deposition.

161. *Quercus virginiana* Miller, live oak. (Figure 15)

a. Description and Life History. An evergreen, monoecious tree to 60 ft tall and with a wide-spreading crown and massive limbs close to the ground. The leaves are leathery, unlobed, lustrous dark green above, paler beneath. They are variable in size and shape, 2 to 4.75 in. long and 0.3 to 2.3 in. wide. These variations often occur on the same tree. The acorns are black, shiny, about 0.75 in. long, and nearly half their length is enclosed in the cup. This species has resistance to salt wind.

b. Habitat. Full sun to partial shade; sandy woods, fields, dunes, along roads.

c. Soil Requirements. Moist to well drained, dry; pH 5.5 to 7.5; sands, sandy soils of Coastal Plain to finer textured soils.

d. Establishment and Maintenance. Live oak is easily propagated with acorns collected as soon as they ripen in the fall. It is best to plant the seeds immediately since they will sprout and establish a tap root during the late fall months. Acorns may be planted on the dredged material which has an established, protective vegetative ground cover, preferably a perennial grass. If planting is to be delayed, the seeds must be stratified at 38° to 40°F. Stratified seeds will sprout and die in the refrigerator if held longer than three months.



Figure 15. *Quercus virginiana*, live oak. A, habit; B, branch with leaves and acorns. (SCS photo)

Oak seedlings have a long taproot which is often damaged when the seedlings are dug. As a result, the survival rates of transplants in the field are often low. Direct planting of acorns has the advantage of overcoming the problems of root damage. If the site is very poor, a shovelful of topsoil or humus mixed with the soil will ensure better growth. This is recommended for both seedling and acorn plantings. If only a few plants are needed, acorns may be planted in gallon cans and transplanted after a year of growth. In the field, space seedlings 10 to 24 ft apart. Because live oak is naturally slow growing, application of fertilizer for the first few years of establishment is helpful. About 0.75 oz (a rounded tablespoon) of 8-8-8 or 10-10-10 fertilizer in two slits 6 in. from the stem or broadcast in a 1-ft circle around the stem is recommended.

e. Disease and Insect Problems. The larvae of acorn weevils are often present inside the acorns and feed on the cotyledons. Fall planting or stratification of the acorns greatly reduces the extent of the weevil damage.

f. Wildlife Value. High food and cover value. Live oaks are common plants on dredged material areas along the southeast coast. The specific use of live oak, although not well documented, is probably very high. Martin et al. (1951) document the high value and many uses of oak species in general and list the live oak as of particular importance to wildlife in the Southeast. Live oaks, primarily their acorns, are probably used by all of the users listed by Martin et al. (1951) which occur in the live oak's range. Davison (1967) states that live oak acorns are a choice food of bobwhite, whooping crane, blue jay, tufted titmouse, wild turkey, red-bellied woodpecker, and red-headed woodpecker. The acorns are probably eaten by the white-tailed deer, eastern gray squirrel, eastern fox squirrel, raccoon, and many other mammals. The acorns are eaten by waterfowl, especially the mallard, black duck, and wood duck (Martin and Uhler 1951).

The live oak is evergreen and grows both as a shrub and tree. In some areas it grows as dense thickets. As such, it provides excellent nesting habitat for birds and thick year-round protective cover for birds, small mammals, and white-tailed deer. The trees also are excellent squirrel habitat. Live oak trees and thickets on dredged material areas along the southeast Atlantic and Gulf coasts are known nesting and roosting areas for large colonies of herons, egrets, ibises, boat-tailed grackles, and red-winged blackbirds.

Shrubs

162. Genus *Amelanchier*, serviceberries. Approximately 20 species of serviceberries or Juneberries, as they are sometimes called, grow in a variety of habitats throughout the United States; the greatest number occur in the West. Though typically shrubs, some species attain tree stature. Many are closely related, and they hybridize freely. Consequently, they are difficult to distinguish, and taxonomic confusion exists in regard to certain species. In addition to their wildlife value, the serviceberries are particularly desirable for their attractive clusters of white flowers which appear before the leaves. They are among the earliest woodland shrubs and trees to flower. The small apple-like fruits are edible and are made into pies and preserves.

163. In addition to the species listed below, other possibilities for wildlife habitat development are common serviceberry (*Amelanchier arborea*), coastal Juneberry (*Amelanchier obovalis*), and western serviceberry (*Amelanchier alnifolia*).

164. *Amelanchier canadensis* (L.) Medicus, Canadian serviceberry.
(Figure 16)

a. Description and Life History. An upright shrub or small tree to 20 ft with several smooth, gray trunks in a clump; it is not stoloniferous. Young twigs are hairy until fruit is formed. The 1- to 2.5-in. leaves are oval to oblong, somewhat rounded at both ends, with fine, sharp teeth along the margins. Dense, ascending clusters of white flowers bloom from March to April before the leaves appear. The reddish to blackish apple-like fruits (about 0.25 in. in diameter) are juicy and sweet when they ripen in May and June. Growth is moderate.

b. Habitat. Full sun to partial shade; swamps, wet woods, moist roadside thickets, sandy upland woods.

c. Soil Requirements. Wet, moist to well drained; pH 4.6 to 6.5; alluvial soils, sandy loams, clays.

d. Establishment and Maintenance. Canadian serviceberry can be reproduced from seeds, cuttings, and suckers. Seeds are collected immediately when ripe before they are eaten by wildlife. Seeds should be cleaned immediately by macerating the fruit in water and washing over screens to remove the pulp. They should then be dried. If the seeds cannot be extracted promptly, the fruit should be spread out in a thin layer to dry but should not be overheated or viability will decrease. Cleaned seeds can be sown in fall or stored dry in sealed containers kept at 41°F prior to stratification at 34° to 41°F for 3 to 5 months. For nursery stock, plant in drills of 25 seeds per linear foot and 0.25 in. deep. Beds should be mulched until seeds germinate.

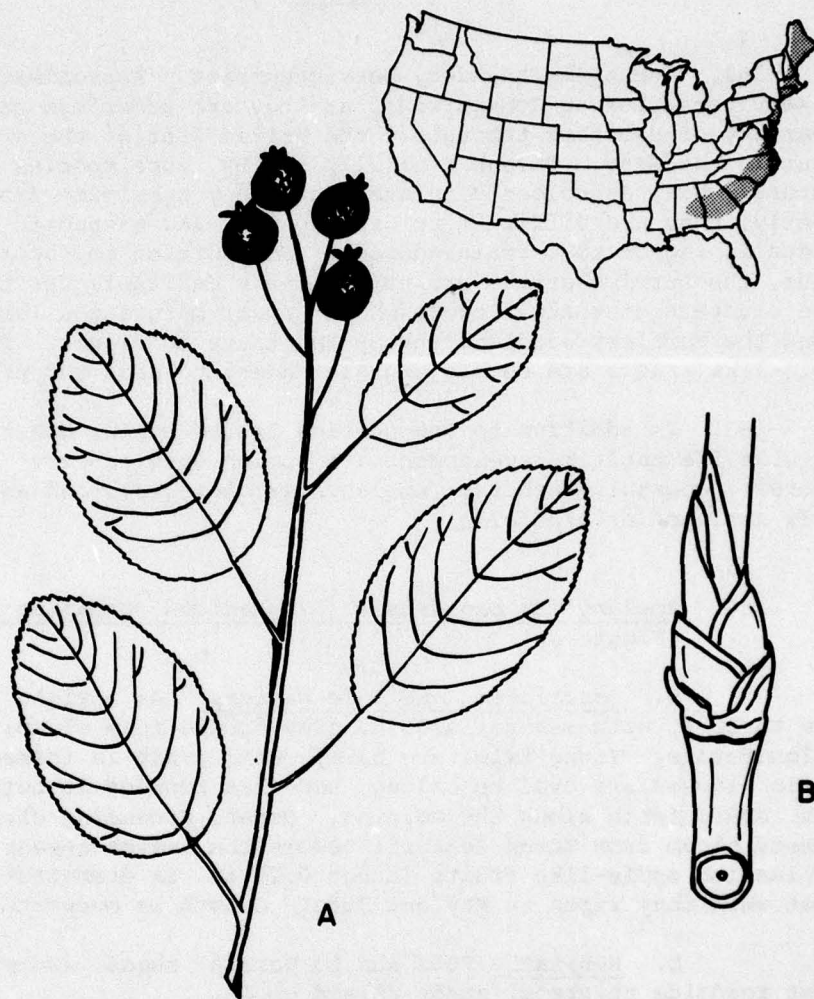


Figure 16. *Amelanchier canadensis*, Canadian serviceberry. A, twig with leaves and fruit x 1; B, twig detail x 1.

and should be kept half shaded for the first year. Fall planting in a cold frame is known to yield good seedling production. One-year-old seedlings should be transplanted. They will be ready for field planting 2 to 3 years later (Schopmeyer 1974).

Planting stock can be rapidly attained from spring or fall cuttings taken from vigorous plants. Root and softwood cuttings root readily, especially if treated with a rooting hormone and given bottom heat (Gill and Healy 1974). For maximum fruit production, plant in full sun.

e. Disease and Insect Problems. The genus *Amelanchier* is recognized as a host for the cedar-apple rust that causes spots on the fruit and leaves of apples. It also is the host of a minor fungus pathogen, *Tympanis amelanchieris*; neither, however, should create significant problems on dredged material disposal sites.

f. Wildlife Value. High food value, low cover value. The fruits of Canadian serviceberry, an important wildlife food during the early summer period, are especially sought after by songbirds and are relished by squirrels, chipmunks, and bears (Martin et al. 1951). Van Dersal (1938) lists stomach records for 27 species of birds, including the ruffed grouse, and for the white-tailed deer; he reports feeding observations for additional species, including the bobwhite, mourning dove, and cottontail. Davison (1967) states that the fruit is a choice food of the cardinal, rose-breasted grosbeak, ruffed grouse, eastern kingbird, mockingbird, Baltimore oriole, robin, scarlet tanager, brown thrasher, hermit thrush, wood thrush, veery, red-eyed vireo, cedar wax-wing, and hairy woodpecker and is a fair food for the yellow-shafted flicker and common grackle.

The cover value of Canadian serviceberry is limited; it provides perching and nesting sites for birds.

165. Genus Atriplex, saltbushes. The genus *Atriplex*, commonly called saltbush because of the salty taste of the leaves, includes both shrubby and herbaceous species. These plants are extremely drought resistant and are commonly found on alkali flats, along shores, on dunes, and in waste places. They are important for western wildlife as both food and cover and are sometimes called "quail brush" because of their importance for western quails. Wingscale (*Atriplex canescens*) is discussed below; however, other species such as *Atriplex lentiformis*, *Atriplex polycarpa*, and *Atriplex breweri* are western species which also may be suitable for wildlife habitat development on dredged material.

166. *Atriplex canescens* (Pursh) Nuttall, wingscale. (Figure 17)

a. Description and Life History. A much-branched and deep-rooted evergreen shrub to 8 ft. The branches are gray, scurfy to smooth. Leaves are alternate, sessile, 0.4 to 2 in. long and 0.1 to 0.5 in. wide, and variable in shape--linear, elliptic, oblong, or spatulate. The leaf apex is usually rounded, the base cuneate, and both surfaces gray and scurfy. The male and female flowers open from May to September. As the fruits mature in late summer, the subtending bracts develop two pairs of entire or toothed veiny wings. The enclosed seeds are brown, about 0.1 in. long and remain on the bush, sometimes through the winter and into spring. Wingscale has excellent drought resistance and tolerates a wide range of soil conditions.

b. Habitat. Full sun to partial shade; field margins, ditch banks, grassy uplands, salt flats, sandy deserts.

c. Soil Requirements. Dry (5 in. annual precipitation minimum requirement); pH 7.0 to 11.0; medium to moderately coarse-textured soils.

d. Establishment and Maintenance. Seeds (fruits) can be gathered when ripe (from November to December) by hand or by hand-carried vacuum machine. Cleaning is not required; about 50 percent of the seeds are viable. They can be stored for several years in a dry place and retain their viability. Sow by broadcasting, either by hand or aerially, or by drilling in sandy loam, covering slightly, and rolling. The seedlings are susceptible to damping-off during the first 2 weeks of sprouting. The best times for sowing depend upon soil moisture conditions; generally they are from late winter to early summer. Four to 8 lb per acre of dewinged seeds or 8 to 15 lb of winged seeds are recommended. Mulching improves seedling establishment. Strip planting of wingscale is preferred over solid stands for wildlife utilization. The stands naturally thin themselves.

e. Disease and Insect Problems. None.

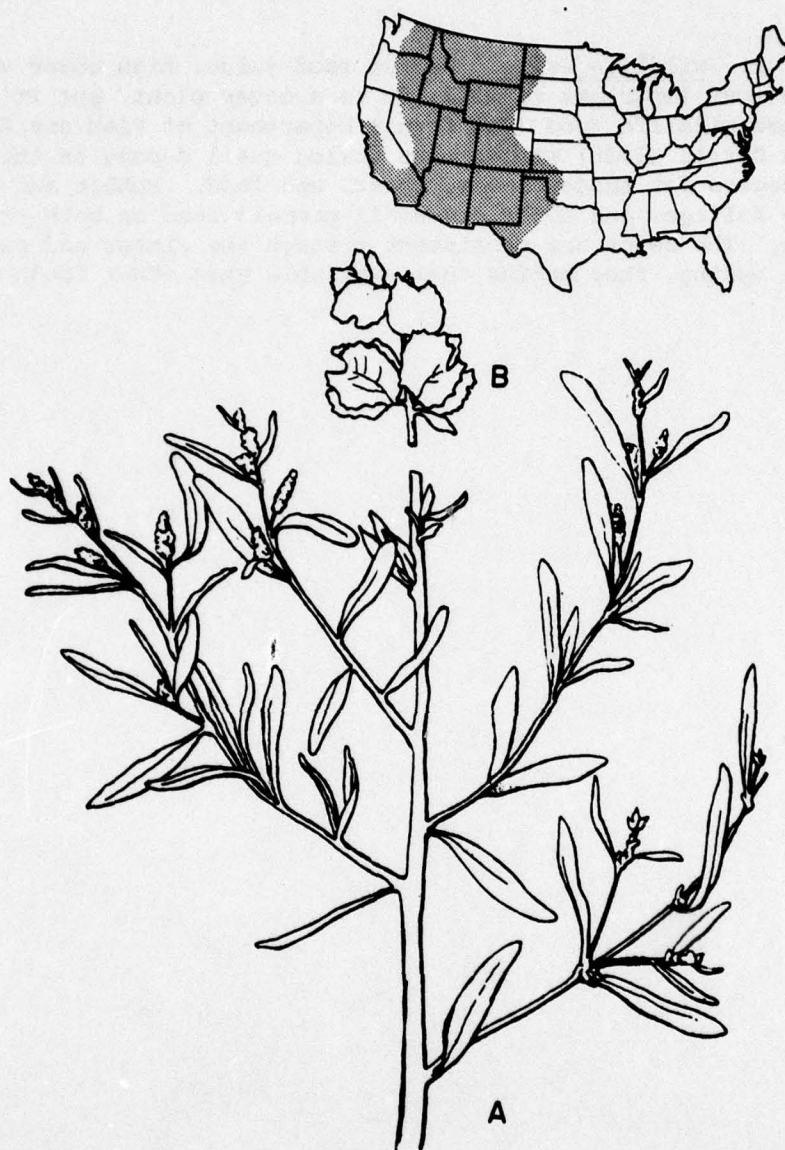


Figure 17. *Atriplex canescens*, wingscale. A, branch with flowers x 0.5; B, fruit x 0.5.

f. Wildlife Value. Medium food value; high cover value. *Atriplex* is most important to wildlife as a cover plant, but it also provides some wildlife food (California Department of Fish and Game 1968). Van Dersal (1938) states that scaled quail depend on this plant to a high degree for shade, cover, roost, and food. Rabbit and deer feed on the foliage, and birds and small mammals feed on both the seeds and foliage. The seeds are persistent through the winter and sometimes through the spring, thus making them available when other foods may be scarce.

167. Genus Callicarpa, beautyberry. Only one species of beautyberry is native to the United States; it is confined to the Southeast and has been cultivated for the distinctively attractive fruit. Other species, such as the Japanese beautyberry (*Callicarpa japonica*), have been introduced as ornamentals.

168. *Callicarpa americana* L., beautyberry. (Figure 18)

a. Description and Life History. A deciduous shrub to 6 ft with relatively open, unbranched, upright growth. The opposite, soft-textured, aromatic leaves are oblong, pointed at both ends, 2 to 7 in. long and 2 to 3.5 in. wide. The margins are coarsely serrated except near the tip. Clusters of small pink or pale blue flowers appear in the spring in the leaf axils. The fall-ripening fruit form showy, tight clusters of rose to lavender or blue flesh berry-like drupes which are 0.13 to 0.25 in. long. The showy fruit clusters occur at regular intervals along the stem and remain into the winter. Beautyberry is moderately sensitive to salt spray.

b. Habitat. Sun to semishade or shade; road edges, field borders, coastal woodlands and thickets.

c. Soil Requirements. Moist, well drained, dry; pH 5.2 to 7.0; moist to dry, sandy or rocky to rich soils.

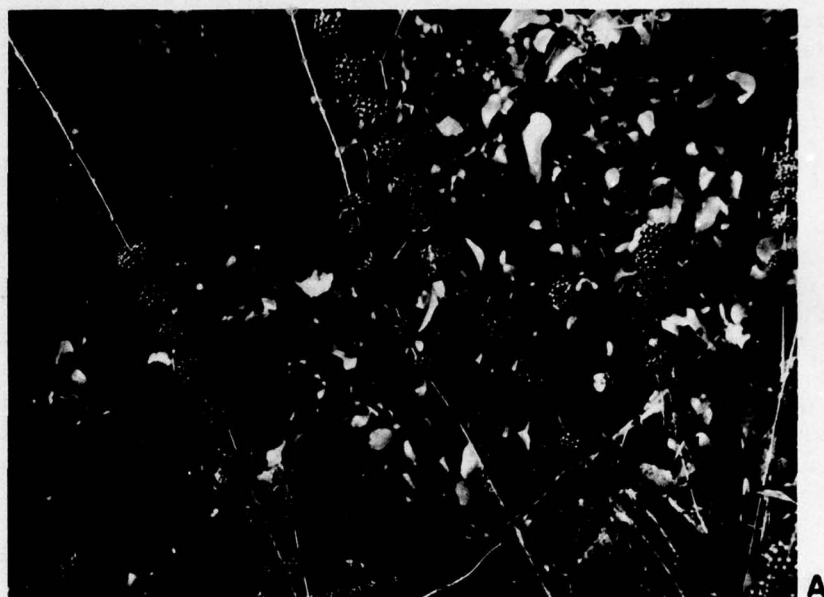
d. Establishment and Maintenance. Plantings of seeds are made in the fall with seeds that have just ripened or, if made in the spring, the seeds must be stratified for 2.5 to 3 months prior to planting. Untreated cuttings taken in early October in Amherst, Massachusetts, and set in sand under glass rooted 75 percent. Rooting is hastened by treatment with a rooting hormone such as Hormodin or Rootone (Doran 1937, N. C. Wild Flower Preserv. Soc., Inc. 1977).

Rooted seedlings and cuttings should be planted during the dormant season. Plant 4 to 6 ft apart. If the site is "exposed", the presence of a protective cover planting is a necessity.

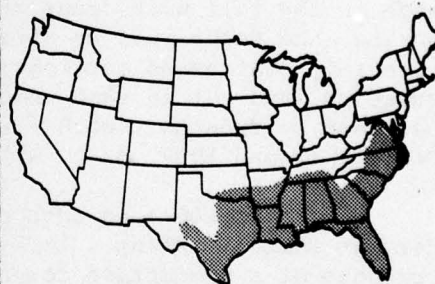
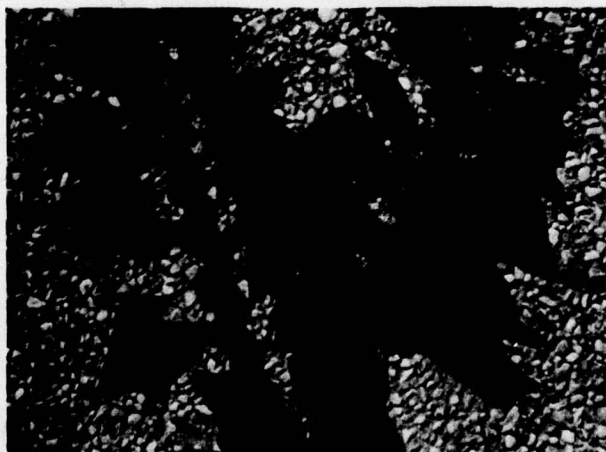
Maintenance for this kind of planting is needed only where satisfactory growth is lacking during the establishment period. If, in time, the shrubs get too leggy they may be cut back severely, almost to the ground. This promotes sprouting of new stem growth which will flower and fruit within the same season.

e. Disease and Insect Problems. These shrubs are usually pest and disease free; however, they are occasionally attacked by defoliating insects which can be dispatched by spraying with Sevin.

f. Wildlife Value. Medium food and cover value. The berry-like fruit persists well into the winter. The fruit is relished



A



B

Figure 18. *Callicarpa americana*, beautyberry. A, habit; B, branch with fruit. (SCS photos)

by white-tailed deer and the leaves and twigs are browsed as well (Lay 1961a). Davison (1967) states that it is an occasional nest plant and that the fruit is a choice food of the cardinal, mockingbird, brown thrasher, and wood thrush and a fair food of the bobwhite, catbird, and robin. Van Dersal (1938) reports that stomach records of 10 species of birds included the fruit and that the fruit ranked 41st on the list of preferred quail plants of the Southeast. He also reports feeding observations of captive marsh rabbits. Martin et al. (1951) list the armadillo and raccoon as minor users of the fruits.

169. Genus *Cornus*, dogwoods. The genus *Cornus* consists of small trees or shrubs commonly found as understory plants in bottomland forests, in swamps, and on cool north-facing slopes. The species vary in their habitat requirements, but most prefer moist, fertile, well-drained soils. They are shallow-rooted and subject to drought-induced mortality. The wood is extremely hard and durable. Generally they have little tolerance to alkaline soils. Conditions on many dredged material areas would be too extreme for most dogwood species. Redstem dogwood (*Cornus stolonifera*), discussed in detail below, has the widest geographic range and is highly adaptable. The rough-leaf dogwood (*Cornus drummondii*), which tolerates alkaline soil, is prevalent on dredged material in the Mississippi River Basin and may be a good choice for habitat development in that area.

170. *Cornus stolonifera* Michaux, redstem dogwood. (Figure 19)

a. Description and Life History. A stoloniferous thicket-forming shrub to 7 ft. The smooth, slender, opposite branches are bright red when young and turn grayish brown and rough with age. The oblong opposite leaves are paler green on the lower surface than on the upper. White, flat-topped flower clusters 1 to 3 in. across are borne at the tips of new branches from middle to late spring. The white- to lead-colored fruit (drupes) are 0.25 in. long with a hard seed inside and ripen from midsummer to early fall. Though redstem dogwood is a rapid grower, fruits are not produced until the plants are 3 to 4 years old. This tough, rugged species is adaptable to a wide range of soil types and moisture regimes.

b. Habitat. Full sun to partial shade; swamps, low meadows, river banks, creek banks, fields, woodland borders.

c. Soil Requirements. Wet, poorly drained to well drained; pH 3.2 to 8.0 (optimum, pH 5.0 to 6.5); poorly drained muck, silt loam, alluvial soils, gravelly sand, sandy upland soil, calcareous gravel, dry humus peat.

d. Establishment and Maintenance. Redstem dogwood plants are often available commercially. They can be propagated in a number of ways. Vegetative techniques are highly successful; consequently, using such methods as cuttings, layering, or clump division are recommended. Softwood cuttings taken in early August have rooted 100 percent within 5 weeks, and hardwood cuttings made in mid-April have rooted 90 percent in 8 weeks (Doran 1937). A sand medium gives the best rooting results. Rooted cuttings should be planted after one growing season in the early spring while still dormant. Though less reliable, fresh unrooted hardwood cuttings 0.38 to 0.5 in. in diameter and 9 in. long may be planted while dormant. Both rooted and unrooted cuttings should be planted with 2 in. of wood above the surface. The planting hole should be large enough to accommodate the root system when well

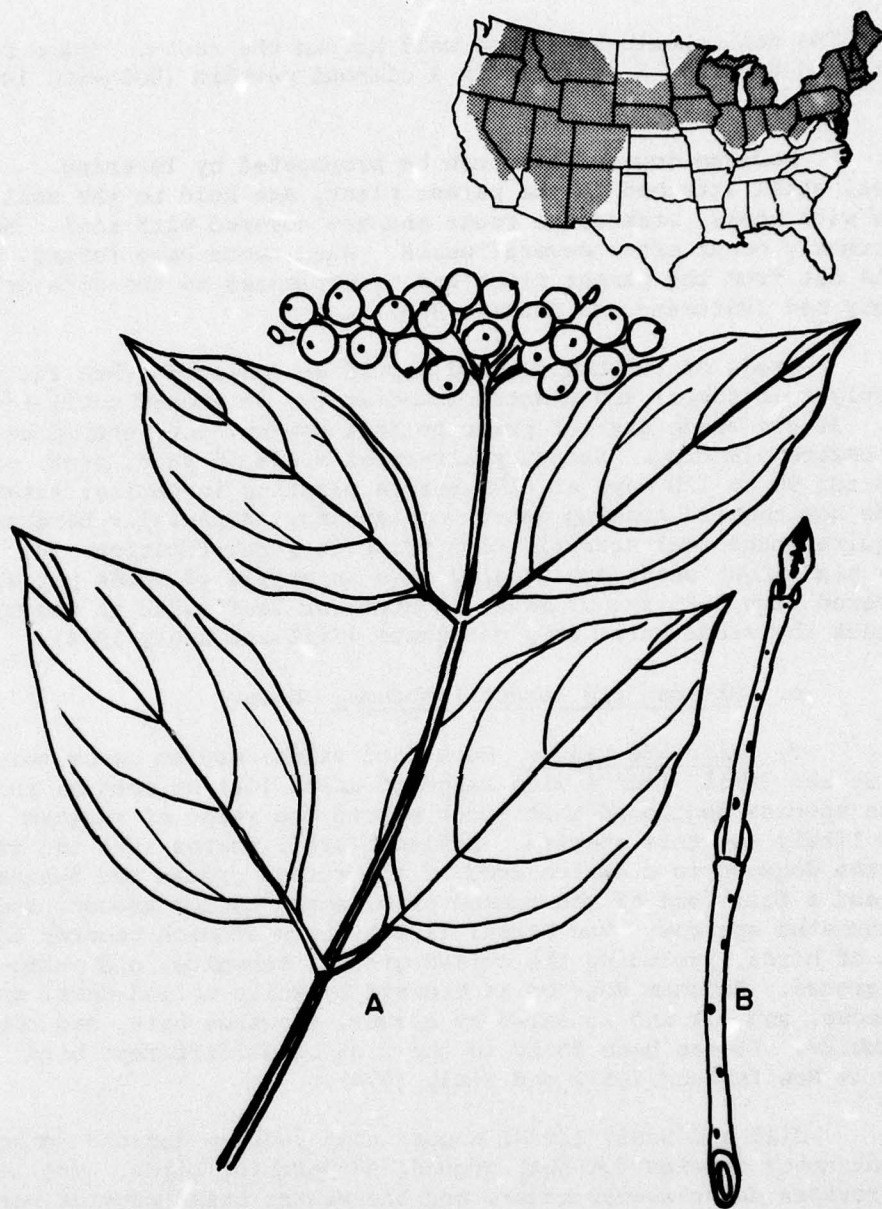


Figure 19. *Cornus stolonifera*, redstem dogwood. A, twig with leaves and fruit x 1; B, twig detail.

spread. The soil should be firmed well around the roots. Space rooted and unrooted cuttings 2 ft apart in a diamond pattern (USDA-SCS 1969-1976).

Redstem dogwood also can be propagated by layering. Branches, still attached to the parent plant, are held to the soil surface with hooks, stakes, or rocks and are covered with soil. Rooting will normally occur after several weeks. When roots have formed, the shoot is cut from the parent plant and transplanted to the site or to a nursery bed (Hartmann and Kester 1968).

Seeds of redstem dogwood should be collected when fully ripe (late July to October) and planted immediately, or stored until the next spring. If the seeds dry out prior to fall sowing, they should be soaked before planting. Stratify air-dried seeds in sand, peat, or a mixture for 90 to 120 days at 41°F before planting in spring; stratified seeds do not require soaking prior to planting. Especially hard seeds may require mechanical scarification prior to stratification. For nursery plantings, seeds are usually sown in drills 40 seeds per sq ft and covered with 0.25 in. of soil. A straw or leaf mulch is recommended to protect the seeds until they germinate (Gill and Healy 1974).

e. Disease and Insect Problems. None.

f. Wildlife Value. High food value; medium cover value. Martin et al. (1951) list a wide range of users (64) of *Cornus*; those wildlife species mentioned that occur within the range of redstem dogwood likely use this species. Davison (1967) states that the fruit of redstem dogwood is a choice food of the ruffed grouse and Swainson's thrush and a fair food of the common crow, sharp-tailed grouse, and white-throated sparrow. Van Dersal (1938) lists stomach records for 12 species of birds, including the ruffed grouse, bobwhite, and sharp-tailed grouse. Redstem dogwood is browsed by white-tailed deer, mule deer, moose, and elk and is eaten by beaver, snowshoe hare, and cottontail rabbits. It has been found in the diet of 93 different bird species in New England (Gill and Healy 1974).

Gill and Healy (1974) report that redstem dogwood is an important cover species for both ground and perching birds. The leafed plant provides dense summer cover, and the winter stems provide partial cover.

g. Comments. Because of its rapid growth on moist sites and its ease of propagation, redstem dogwood has proved very successful in stabilizing stream banks and gullies and also for establishing windbreaks.

171. Genus *Elaeagnus*, *elaeanus*. The dozen or so species of *Elaeagnus* common in the United States are cultivated species introduced from Europe and western Asia. The single native representative is silverberry (*Elaeagnus argentea*), a cold climate species found from the north central states to Maine. Some species, for instance Russian olive (*Elaeagnus angustifolia*), have become widely naturalized in the plains areas of some of the western states. Summer elaeagnus (*Elaeagnus parvifolia*), a deciduous species which produces its fruit in early summer, has become naturalized in parts of the Southeast. The wildlife value of this genus stems from its dense growth, heavy fruit production, and its ability to grow on poor sites through the action of nitrogen-fixing bacteria on the roots.

172. *Elaeagnus angustifolia* L., Russian olive. (Figure 20)

a. Description and Life History. An exotic shrub or small tree to 20 ft, sometimes spiny, with irregular crown and silvery twigs. The leaves are lance shaped, 1.5 to 3 in. long, blunt pointed with smooth margins, grayish green above, silvery scaly beneath. The June flowers are silvery and pale yellow, 0.37 in. long, and fragrant. The fruits are 0.37 to 0.5 in. long, oval, yellow to tan, at first densely silvery, later becoming shiny. The flesh is yellow, mealy, and sweet and surrounds a single stone which is brown with dark longitudinal stripes.

b. Habitat. Full sun; cultivated as windbreaks, in landscaping, as wildlife plantings in dry plains and plateau areas in western U. S. to 5500 ft.

c. Soil Requirements. Moist to dry; pH 6.0 to 8.0; sandy poor soils to loam, silt, clay.

d. Establishment and Maintenance. In the fall the fruit is gathered by hand, cleaned, and fall planted 0.5 to 0.75 in. deep in nursery bed rows. It is necessary to mulch the beds to improve germination and also to reduce soil splash on leaves and stems. Soil splash may foster fungus disease problems.

For spring planting the seeds are dried and stored in a cool place. They are later stratified for 2 months and then spring planted in nursery beds.

One-year-old nursery stock is usually used for field plantings. Plants usually are grouped 6 to 8 ft apart. Plantings for windbreaks are usually spaced 4 to 6 ft apart.

Russian olive also can be propagated by summer softwood cuttings and root cuttings.

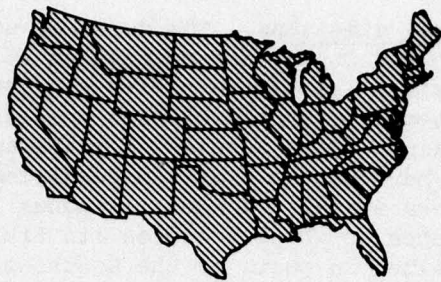


Figure 20. *Elaeagnus angustifolia*, Russian olive. A, twig with leaves and fruit x 0.5; B, twig detail x 1.5.

This species requires little maintenance after establishment. An occasional annual broadcasting of fertilizer will improve fruit production.

e. Disease and Insect Problems. Usually no problems, but is susceptible to cotton root rot.

f. Wildlife Value. High food and cover value. The fruit, usually produced in abundance every year, remains on the tree throughout the winter or until it is consumed. Borrell (1971) states that for wildlife food and cover in the western and plains states, no other shrubby tree surpasses the Russian olive. In addition to various conservation uses, more than 50 kinds of birds and mammals feed on the fruits. Known bird users include the mallard, blue grouse, sharp-tailed grouse, gray partridge, bobwhite, scaled quail, California quail, Gambel quail, ring-necked pheasant, chukar, wild turkey, mourning dove, roadrunner, red-shafted flicker, black-billed magpie, common crow, mockingbird, catbird, brown thrasher, sage thrasher, robin, eastern bluebird, mountain bluebird, Townsend's solitaire, Bohemian waxwing, cedar waxwing, phainopepla, starling, Brewer's blackbird, common grackle, cardinal, evening grosbeak, house finch, pine siskin, house sparrow, lesser goldfinch, green-tailed towhee, rufous-sided towhee, slate-colored junco, Oregon junco, white-crowned sparrow, and song sparrow. Mammalian users include cottontails, ground squirrels, fox squirrels, elk, and deer (Borrell 1971).

Although Russian olive sheds its leaves in winter, its spreading, thorny branches and thicket-forming growth make excellent wildlife cover. Mourning doves, mockingbirds, and other kinds of birds use this plant for nesting (Borrell 1971).

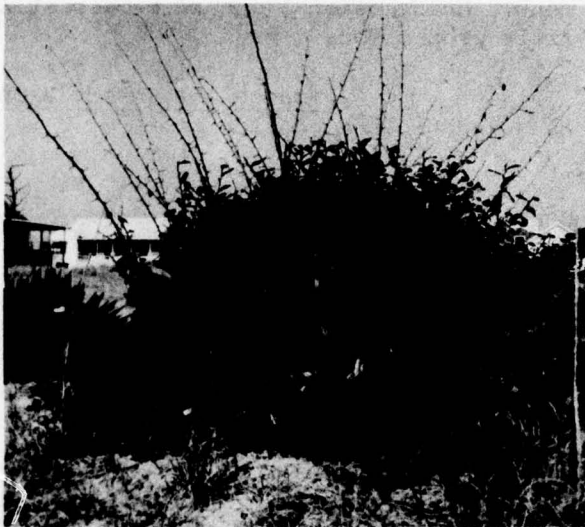
g. Comments. The key characteristics of this plant, in addition to its high wildlife value, are its drought hardiness, tolerance to soil salinity or alkalinity, and adaptability to a wide range of poor to rich soils.

173. *Elaeagnus pungens* Thunberg, thorny elaeagnus. (Figure 21)

a. Description and Life History. A robust, dense-growing, cultivated shrub to 6 to 10 ft. The leaves are evergreen, a lustrous green on top and silvery underneath. In some varieties the stems and undersides of the leaves are speckled with rust-colored scales. Leaves are oblong, 1.5 to 2.75 in. long. Small, very fragrant, brownish-white flowers appear in early fall. Heavy crops of red drupes speckled with silver and about the size and shape of an olive pit mature in April. New growth first appears as elongated, spurred canes which at first are sparsely leaved. As leaves form and grow, the canes arch downward. If supported, these canes become almost vinelike and will climb to heights of 20 ft or more. This genus, like a legume, supports nitrogen-fixing



A



B

Figure 21. *Elaeagnus pungens*, thorny elaeagnus. A, habit; B, twig with leaves and fruits. (SCS photos)

bacteria on its roots. This extra source of plant food enables the plant to endure on very poor sites. In addition, the leaves have very high resistance to salt spray. There are about a dozen varieties of this species. A few of the most hardy and attractive ones are varieties "reflexa," "simoni," and "fruitlandi."

b. Habitat. Full sun to shade; landscaping hedges, specimens occasionally escape from cultivation.

c. Soil Requirements. Moist to well drained to dry; pH 5.0 to 7.5; sands to fine-textured clay, silt, loam.

d. Establishment and Maintenance. This is a very valuable cultivated shrub in conservation work because of its desirable growth habits and wide adaptability to various adverse field conditions. Thorny elaeagnus can be propagated by cleaning the spring-ripened seeds and planting them immediately. Nursery beds must be mulched to prevent soil from splashing on the stems and leaves. (Soil splash often induces a fungus disease.) Spring-planted seeds will not make plantable stock in one season unless fertilized generously. Most propagation is done with cuttings of the new long canes taken in early fall, treated with a hormone, and grown under glass. Such plants will produce a moderate root system before cold weather. The cuttings are lifted in spring just as the flush of new growth starts. They may then be potted in 1-gal containers, fertilized, and allowed to grow through the summer. By fall such stock should be at least 2 ft tall and ready for field planting. Plants in groups are spaced 8 ft apart. Spacing between plants in rows is 6 ft.

If potted plants are used they should be fertilized at planting time below the root zone or in slits around the perimeter; about an ounce per plant is required. In succeeding years an annual broadcasting of 8-8-8 fertilizer will be beneficial.

e. Disease and Insect Problems. Fairly free of disease. Spider mites sometimes attack, but can be controlled with a suitable spray.

f. Wildlife Value. Low food value documented, but medium value probable; high cover value. Davison (1967) states that the fruit is a choice food of eastern bluebird, mockingbird, robin, and cedar waxwing. Graetz (1973) points out that the fruits ripen in late winter and spring at a time when other songbird food is scarce.

The dense evergreen shrub growth is a frequent nest site of the mockingbird, brown thrasher, and towhee (Davison 1967).

174. Elaeagnus umbellata Thunberg, autumn olive. (Figure 22)

a. Description and Life History. A cultivated, widely branching, deciduous shrub to 15 ft. The species develops a deep tap-root which accounts for its resistance to drought. The leaves are pale olive green, silvery beneath, with wavy edges. In spring small, yellow, trumpet-shaped flowers are abundant in dense clusters scattered along the twigs. In the fall this species normally produces a heavy crop of pale red, silver-speckled drupes. They are edible but astringent. Each fruit contains one soft, ridged pit. Autumn olive develops nitrogen-fixing bacteria on its root system. This additional nitrogen enables the plant to succeed on poor sites.

"Cardinal" is the only named variety. It was developed by the USDA Soil Conservation Service in the Northeast region (USDA-SCS 1969-1976).

b. Habitat. Sun to half shade; open fields and borders, windbreaks, mine spoils; specimens occasionally escape from cultivation.

c. Soil Requirements. Moist to well drained; pH 4.8 to 6.5; sand, loam, and clay soils, but not excessively dry or shallow sites.

d. Establishment and Maintenance. Autumn olive may be produced by fall planting cleaned seeds in nursery rows. Mulch is applied over the beds to protect the seeds over winter and to prevent fungus attacks in the spring induced by soil splash on the leaves. Seeds may also be stored dry and stratified for 90 days at 41°F just before spring planting. The former method is preferred. Hardwood cuttings kept moist in moss and refrigerated may be planted under glass in the spring. Softwood cuttings and root cuttings also are successful.

Field plantings can be established with 1-year-old nursery seedlings which are commercially available. Spacing for plants in groups is 8 ft. This spacing ensures maximum fruit production. Plants in rows (hedges, windbreaks, etc.) should be spaced 4 to 6 ft apart.

Spot fertilizing individual plants will hasten development. No additional care may be required. To promote denser growth these shrubs can be trimmed rather heavily.

e. Disease and Insect Problems. None.

f. Wildlife Value. High food and cover value. SCS highly recommends this plant for wildlife and conservation in the Northeast. USDA-SCS (1969-1976) states that the fruits are eaten by 4 species of upland game birds, 2 migratory game birds, 20 nongame birds, and 4 mammals. Allan and Steiner (1972) state, "Raccoons, skunks, opossums,

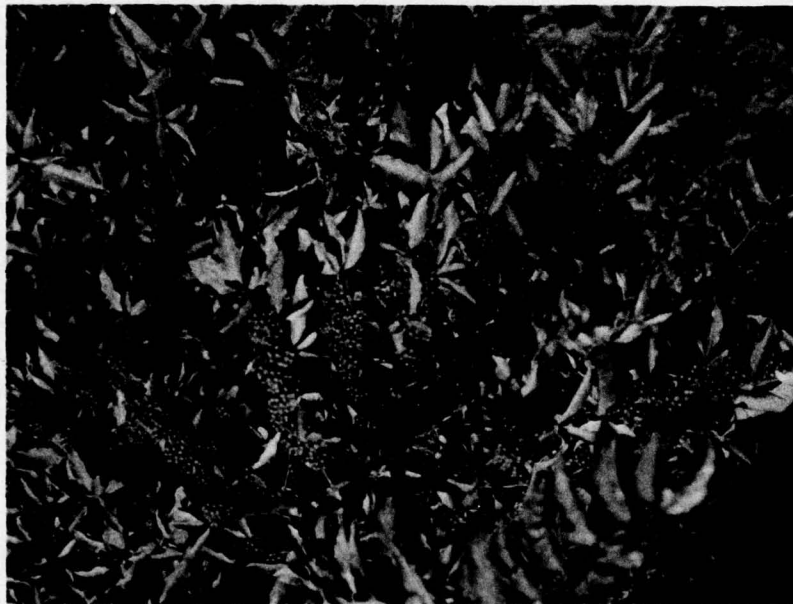
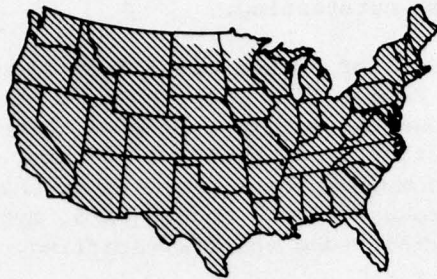


Figure 22. *Elaeagnus umbellata*, autumn olive. Branches with leaves and fruit. (SCS photo)

and even black bears feed on the berries. But it is as a producer of food for birds that autumn olive is most outstanding.

"Birds eat the fruit (berries) of autumn olive from ripening time in September to late winter. Robins have been known to winter north of their normal range despite snows and severe cold when there were plenty of autumn olive berries. Other birds that eat the berries are cardinal, catbird, cedar waxwing, common grackle, evening grosbeak, fox sparrow, hermit thrush, house sparrow, mallard, mockingbird, myrtle warbler, purple finch, rufous-sided towhee, song sparrow, starling, tree swallow, and veery.

"Bobwhite quail, ruffed grouse, mourning doves, ring-necked pheasants, and wild turkeys find autumn olive fruit highly attractive food. But it is so tasty to songbirds that they sometimes leave very little for game birds. Though many of the berries fall by early winter and are available to ground birds such as quail, some of them hang on the twigs well into winter. These are plucked by grouse, pheasants, and small birds."

Davison (1967) states that the fruit is a choice food of the eastern bluebird, cardinal, catbird, mockingbird, robin, tree swallow, hermit thrush, and cedar waxwing and is a fair food of the bobwhite, black-capped chickadee, purple finch, ruffed grouse, slate-colored junco, ring-necked pheasant, and starling. Autumn olive is browsed by deer and cottontail rabbits, and mice feed on the bark. Allan and Steiner (1972) state, "Thickets or rows of fully grown autumn olive furnish good protective cover for many kinds of wildlife--both birds and mammals. Songbirds find the branches excellent places for their nests and game birds and rabbits find shelter under the wide-spreading branches."

175. Genus Ilex, hollies. Approximately 15 native species of holly occur in the United States; the majority are found in the East in moist woodlands or behind sand dunes along the Atlantic and Gulf coasts. Holly species may be deciduous or evergreen and either form trees or shrubs. Generally the bark is smooth and gray. Most species (and plants) are dioecious, so it is necessary to have both male and female plants to ensure fruit set. However, pollen from any species of holly will cause fruit set if the male and female plants flower at the same time. The round berry-like fruits of the various hollies are quite similar; they are either black, blackish-purple, or red. The abundant small white flowers make the hollies important honey plants. Both the foliage and fruit have good wildlife value.

176. In addition to yaupon (*Ilex vomitoria*) and winterberry (*Ilex verticillata*) discussed below, other highly adaptable and possibly suitable species for wildlife habitat development are the shrubby, evergreen gallberry (*Ilex coriacea*) and inkberry (*Ilex glabra*). Possumhaw (*Ilex decidua*) is similar to winterberry; however, its range is more restricted. American holly (*Ilex opaca*) is an attractive tree to both man and animal; unfortunately, it is rather slow to mature. Both native and introduced hollies are significant landscape plants; many native species are available commercially.

177. *Ilex verticillata* (L.) A. Gray, winterberry. (Figure 23)

a. Description and Life History. A deciduous, dioecious shrub or small tree to 15 ft (average height 9 ft) generally arching in form with a rounded crown. The smooth, gray bark becomes roughened with age. The oval to lance-shaped leaves are 1.5 to 3 in. long and half as wide. The underside is usually fuzzy and somewhat paler than the surface. Leaf margins are coarsely and sharply toothed. Clusters of small white male and female flowers that are attractive to bees appear from April to early June. Berry-like fruits, 0.25 in. in diameter, ripen to a bright red from September to early November. The fruits are particularly showy against the gray branches after the frost-blackened leaves fall off. They remain on the plant well into winter until eaten by birds. Winterberry is more tolerant of low temperatures than other native hollies (Vines 1960).

b. Habitat. Full sun to full shade; swamps, low woods, bogs, stream and pond margins, cool moist upland forests.

c. Soil Requirements. Wet to moist; pH 4.5 to 5.5; organic, humus-rich soils, alluvial soils.

d. Establishment and Maintenance. Planting stock and seeds of winterberry are commercially available. It is propagated from seeds or cuttings. Collect seeds when ripe in the fall; clean by macerating with water to remove pulp. Cleaned seeds planted immediately in the

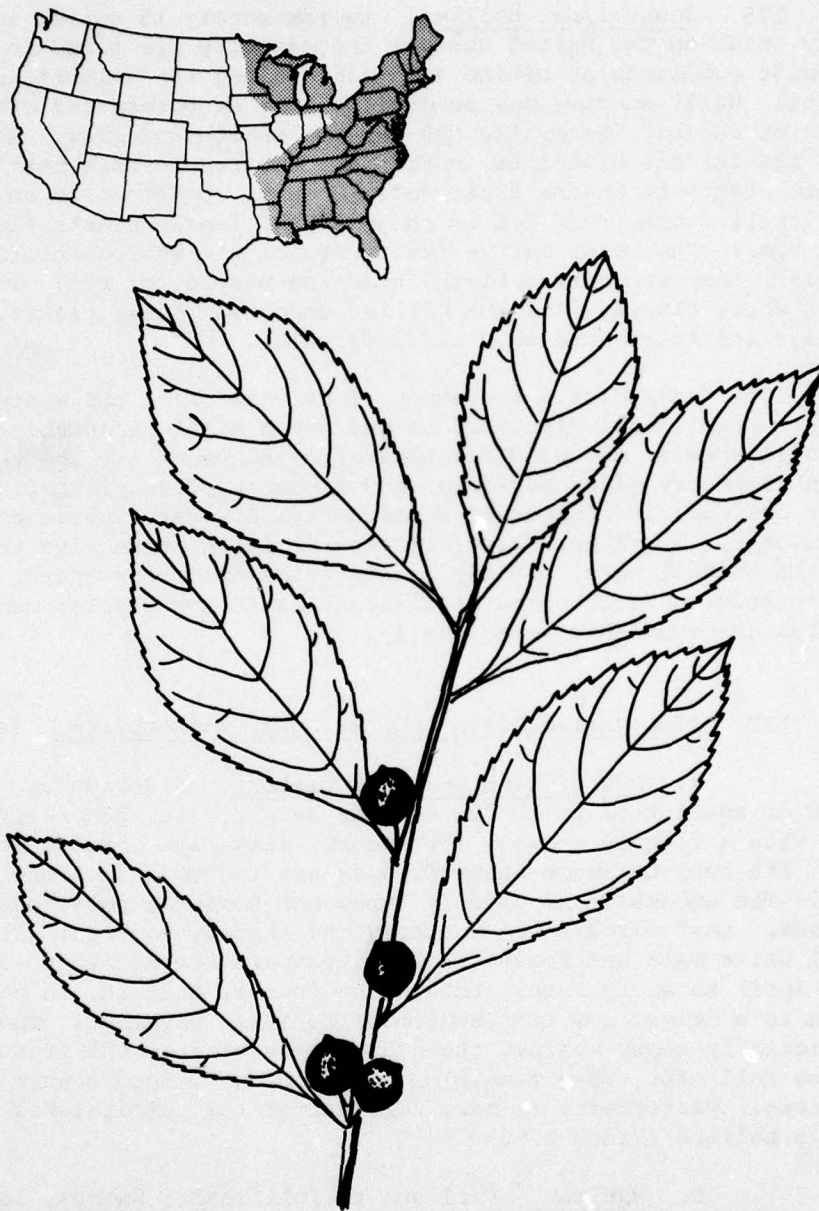


Figure 23. *Ilex verticillata*, winterberry. Twig with leaves and fruit x 1.

fall or stored dry until spring and planted usually do not germinate until the second spring or later. Store dried seeds in dry sealed containers at cool temperatures prior to stratification. Stratify in moist sand at 68°F (nights) and 86°F (days) for 60 days, followed by 60 days in sand flats at normal growing temperatures. Stored seeds remain viable for approximately 1 year (Vines 1960, Gill and Healy 1974).

Propagation from cuttings is somewhat easier than seed reproduction, and the sex of the plant will be known if the source can be identified as male or female. Winterberry commonly produces suckers which are good sources of softwood and hardwood cuttings. Summer and hardwood cuttings can be taken from middle to late summer and into early fall. For best results keep cuttings moist and treat with a rooting hormone before planting; use a rooting medium that has a higher percentage of peat moss than sand. Keep cuttings moist by using a mist system or keeping under glass. After 2 years of nursery growth, transplant in late fall when the soil is relatively dry (Gill and Healy 1974, Hartmann and Kester 1968).

Site preparation may be needed to ensure good growth. Winterberry prefers moist, acid soils with a high humus content. A site may require addition of peat into planting holes. Maintain a good mulch for the first year. Plant in naturally moist areas.

e. Disease and Insect Problems. None.

f. Wildlife Value. High food value; medium cover value. Gill and Healy (1974) state, "Winterberry provides food--fruit, browse, or both--for many species of wildlife. The principal browsers are deer, moose, cottontail and snowshoe hare. The fruit is eaten by various small mammals and more than 48 species of birds. Reported consumers include raccoon, white-footed mouse, red squirrel, ring-necked pheasant, ruffed grouse, sharp-tailed grouse, bobwhite, black duck, wood duck, robin, pine grosbeak, brown thrasher, waxwing, catbird, flicker, thrushes, bluebird, starling, and many other small birds."

Regarding cover value Gill and Healy (1974) state, "Because winterberry seldom forms extensive stands, the cover it provides is usually inferior to that provided by plants such as alders, gray dogwood, sumacs, hawthorns, or greenbriers. But where the latter plants grow in association with winterberry, it may enhance the total cover value, particularly for those small birds that nest on or within 15 to 20 ft above the ground. Winterberry often forms part of such cover in gullies, ditches, and other wet places.

"Because winterberry ranks low in browse preference, it can persist in an understory unless serious overbrowsing occurs."

178. Ilex vomitoria Aiton, yaupon. (Figure 24)

a. Description and Life History. A dioecious, evergreen shrub to small tree 5 to 18 ft. It can form dense thickets with root suckers from the base, or it may be treelike. The leathery leaves are dark green, oval to oblong, and 0.75 to 1.5 in. long. In the spring small greenish-white flowers appear on the previous year's wood. In fall it produces numerous bright, translucent, red drupes which are crowded on the twigs and remain there all winter. Since the plant is dioecious, fruiting occurs only on the female plants. The bark is gray and the new twig ends are purple. This plant is medium to slow growing and has moderate resistance to salt wind burn.

b. Habitat. Sun or shade; mostly near Atlantic and Gulf coasts in woodlands, on sand dunes, in bottomland forests.

c. Soil Requirements. Moist to well drained; pH 4.8 to 7.6; dune sand, sandy soils, less frequently on clay.

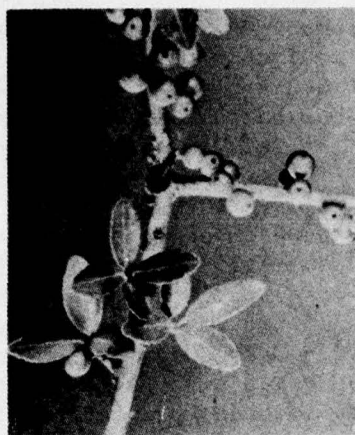
d. Establishment and Maintenance. Yaupon may be propagated with seeds which require two years to germinate. Seeds may be cleaned and stratified and held over until the following fall. They are then planted in nursery beds where they will germinate the following spring.

Yaupon is usually propagated by either stem or root cuttings. Stem cuttings taken from mid-July through August should take root by spring if kept in a cold frame or greenhouse (N. C. Wildflower Preservation Society, Inc. 1977). Rooting response is greatly improved by treating cuttings with naphthaleneacetic acid (Doran 1937). Cuttings secured from female plants ensure production of fruit--providing there are male plants in the vicinity. If there are no male plants nearby, they will have to be included in the planting.

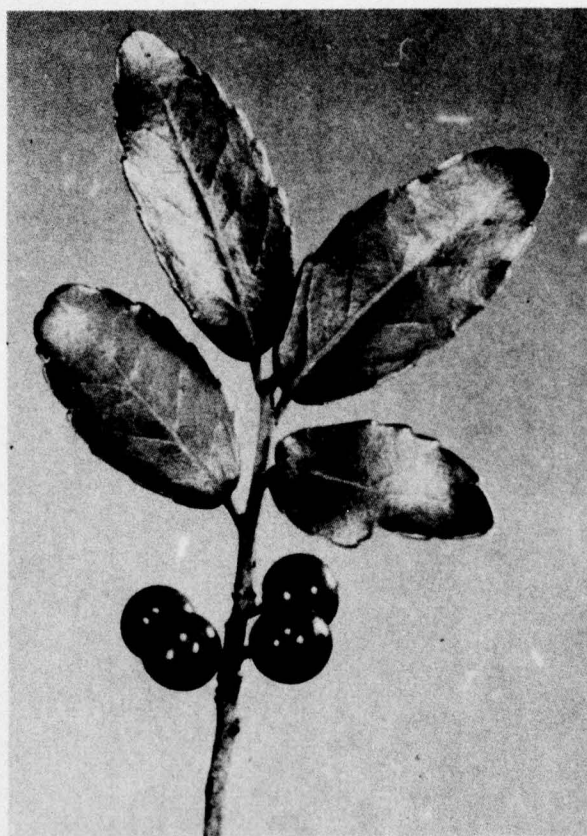
Yaupons do not transplant easily. Thus, containerized or balled stock 1.5 to 2 ft tall is recommended. The spacing in groups is 6 to 7 ft--or 5 to 6 ft apart in rows. After planting they must be watered. In areas exposed to whipping winds and salt spray, these hollies should be planted into a standing grass cover for protection. Annual fertilizer applications will improve growth until plants are well established.

e. Disease and Insect Problems. Yaupon is subject to pitted scale which makes conical pits on the twigs, and tea scale which forms cottony patches on the undersides of leaves. Parathion has been found effective against both (Vines 1960).

f. Wildlife Value. Medium food value; high cover value. Yaupon is a dominant on some dredged material areas in the Southeast. The fruits are sought year-round by white-tailed deer, bobwhite, wild



A



B

Figure 24. *Ilex vomitoria*, yaupon. A, branch with leaves and fruit; B, terminal leaves and fruit.

turkey, raccoon, squirrels, and many songbirds (Lay 1961b). Davison (1967) states that the fruit is a choice food of the mockingbird and cedar waxwing. Van Dersal (1938) recorded fruits in stomach records of seven species of birds, including the bobwhite. The leaves and twigs are readily eaten by white-tailed deer in fall and winter, and year-round on heavily stocked ranges.

Yaupon is an evergreen shrub which on some dredged material sites forms dense thickets, often in association with wax myrtle, live oak, and loblolly pine. Thus it provides excellent nesting sites and year-round cover for many species of wildlife, especially birds. The thickets are used for nesting and roosting sites by various wading birds (herons, egrets, and ibises) and by landbirds such as red-winged blackbirds, boat-tailed grackles, cardinals, towhees, painted buntings, mockingbirds, fish crows, and others.

179. Genus *Lespedeza*, lespedezas. The development and use of perennial shrub lespedezas for wildlife has taken place in the South and Southeast during the past 35 years. The seeds were found to be a choice food of the bobwhite quail, with little use by other animals. This promoted the use of these shrubs specifically for quail, the undisputed king of upland game birds in the South. The seeds resist deterioration after they ripen and fall and will carry over on the ground until the next crop ripens the following fall. This provides a continuous and dependable source of food for quail. All shrub lespedezas depend on insect pollination and are moderately good honey plants.

180. In addition to bicolor lespedeza discussed below, there are other important shrub lespedezas. Japonica lespedeza (*Lespedeza japonica*) requires less management than bicolor lespedeza in that its stems die back to the ground each winter; this trait dispenses with the need for cutting back. Japonica lespedeza seeds ripen from 2 to 3 weeks earlier than bicolor lespedeza. As a result, it extends the range of shrub lespedeza to the north. In Florida, bicolor lespedeza is severely damaged by pocket gophers which girdle the roots and deer which browse on the foliage. Thunberg lespedeza (*Lespedeza thunbergii*) is resistant to both of these troubles and has largely replaced the use of bicolor lespedeza in Florida.

181. *Lespedeza bicolor* Turczaninow, bicolor lespedeza.
(Figure 25)

a. Description and Life History. Open branched rather formless deciduous shrub to 10 ft with several grooved stems of very hard wood. Leaves are composed of three leaflets, each 0.75 to 2 in. long with stringy hairs on both sides or smooth on top. Rosey-purple flowers are borne in loosely arranged clusters at branch terminals in late summer. Single-seeded, broadly elliptical, hairy pods about 0.3 in. long ripen in mid-October. Seeds are shiny, olive green mottled with purple, and about 0.13 in. long.

This is a fast growing legume which can endure poor soil and drought conditions. The stems do not die back to the ground in the winter as with Japonica lespedeza.

b. Habitat. Sun to 50 percent shade; open woods, fields, roadsides, mostly plantings for wildlife or escapes from such plantings.

c. Soil Requirements. Moist to well drained; pH 4.4 to 6.5; sandy soils to eroded or fertile loams, clays.

d. Establishment and Maintenance. Nursery stock is available from commercial dealers, or nursery stock can be produced by planting scarified seeds in nursery beds in the spring. One-year-old seedlings have well-developed root systems which must be trimmed back

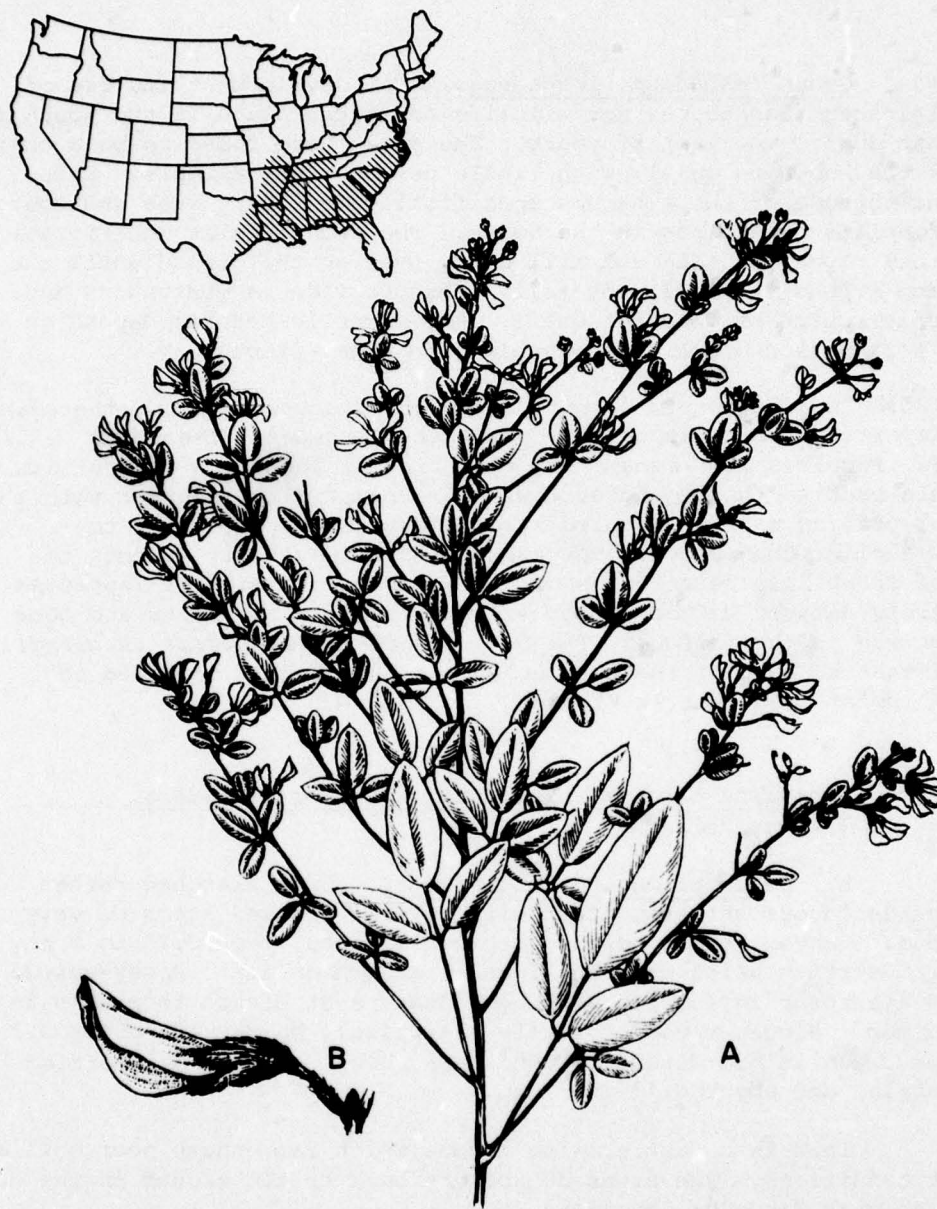


Figure 25. *Lespedeza bicolor*, bicolor lespedeza. A, habit x 0.5; B, flower x 2.5.

somewhat to facilitate planting. Seedlings are planted in groups with plants about 3 ft apart.

Direct seeding is a customary practice on agricultural land. It will also work well on some dredged material sites providing wind and water erosion is not too great a hazard. However, such disadvantages can be overcome by planting into a protective cover crop. Seeding rates are 8 lb of scarified seeds broadcast per acre or 3 to 4 lb drilled in rows 3 ft apart.

Bicolor lespedeza seeds do not ordinarily require inoculation before planting. However on dredged material the required forms of bacteria may be missing; therefore, the use of lespedeza inoculant is suggested.

Usual maintenance is to cut the shrubs to the ground every 2 or 3 years. This forces additional sprouting and prevents tall leggy growth.

e. Disease and Insect Problems. A few insects, such as the twig-girdler beetle and leaf-hoppers are known to feed on bicolor lespedeza, but none seriously harm the plants. No fungal or bacterial diseases have been observed.

f. Wildlife Value. Low food value; medium cover value. The seeds of bicolor lespedeza, and most other lespedezas as well, are not eaten by many animals other than the bobwhite. Once the plants are established, seeds which fall to the ground in the fall remain through the following winter and summer without deteriorating. Thus, this plant provides readily available food year-round for the bobwhite and is important for bobwhite management in the Southeast. The seeds are also occasionally eaten by the wild turkey and mourning dove. Eastern cottontails feed on the seeds, foliage, and bark and white-tailed deer browse the plants.

Bicolor lespedeza provides good cover used by birds and small mammals for concealment and protection while feeding, resting, or nesting.

g. Comments. The range map should be checked carefully before selecting bicolor lespedeza. If it is moved too far north, seed crops will not have time to mature before frost.

In addition to "common" bicolor, two additional strains have been developed: strain 100, which is more productive than common, and strain 101 which is the most vigorous, has the best seed yield, and holds its seeds longest.

182. Genus *Myrica*, wax myrtles and bayberry. These evergreen shrubs or small trees occur primarily in coastal areas but extend inland in some regions. Approximately seven species are native to the United States. The majority occur along the Atlantic and Gulf coasts--of these, wax myrtle (*Myrica cerifera*) and northern bayberry (*Myrica pensylvanica*) are the most prevalent and offer the greatest potential for establishment on dredged material areas. Of the two western species, the Pacific wax myrtle (*Myrica californica*) is the only one growing at low elevations along the Pacific coast. Occurring on stable sand flats behind the foredunes, it has potential for establishment on dredged material. The aromatic wax which coats the fruit of all species has been used since colonial times to make candles. The various *Myrica* species have high ornamental value because of the attractive evergreen foliage and adaptability to a wide range of growing conditions.

183. *Myrica californica* C. & S., Pacific wax myrtle.
(Figure 26)

a. Description and Life History. An evergreen, thicket-forming large shrub or small tree to 35 ft with slender ascending branches and smooth gray or light-brown bark. The glossy, dark-green leaves are oblong to oblanceolate, 2 to 4.5 in. long, and 0.5 to 0.75 in. wide. The leaf margins may be evenly and sharply toothed or almost entire. From March to April, inconspicuous catkins of male and female flowers are borne on the same plant. Small, globose, nut-like fruits, 0.17 to 0.25 in. in diameter, ripen in September. A grayish-white wax coats the brownish-purple fruit which fall from the branches in early winter.

b. Habitat. Partial shade to full sun; moist gullies and canyons, saltmarshes, sand dunes.

c. Soil Requirements. Wet to moist to moderately well drained; pH 5.5 to 7.0; sands, sandy soils, peaty soils.

d. Establishment and Maintenance. Pacific wax myrtle can be propagated from cleaned seeds planted and mulched in the fall or stratified for 3 months and planted in spring. Seeds should be planted about 0.25 in. deep (Emery 1964, Schopmeyer 1974).

According to Grant and Grant (1967), Pacific wax myrtle is easy to grow and transplants readily from the wild; it grows particularly well in slightly acid, peaty soils. Pacific wax myrtle is also recommended for sites that are intermittently wet or that have a high water table (Brown and Hafenrichter 1962). Along the northern Pacific coast the optimum period for planting shrub and tree stock has been found to be from mid-November through January. Six-foot spacing between plants is recommended (Brown and Hafenrichter 1962).



Figure 26. *Myrica californica*, Pacific wax myrtle. Twig with leaves and fruit x 1.

e. Disease and Insect Problems. None.

f. Wildlife Value. Food value not well documented, but medium food value probable; high cover value. Fruit is available in June and July and is persistent until early winter when it drops from the branches. It is likely eaten by a variety of birds; however, only five bird species were documented by Martin et al. (1951) and Van Dersal (1938). These were chestnut-backed chickadee, Audubon warbler, myrtle warbler, wren-tit, and California quail. Other species of *Myrica* are known foods of waterfowl, but Martin and Uhler (1951) mention that there is no evidence that Pacific wax myrtle is sought by ducks. However, this species is probably used by a variety of bird and animal species as are its eastern counterparts, *Myrica cerifera* and *Myrica pensylvanica*. Thicket-forming and evergreen, Pacific wax myrtle provides excellent cover for wildlife.

184. *Myrica cerifera* L., wax myrtle. (Figure 27)

a. Description and Life History. Evergreen dioecious shrub usually 8 to 10 ft but in favored places becoming a small tree to 36 ft. The leaves are yellowish green, 1.5 to 3.3 in. long, 0.25 to 0.75 in. wide, and narrowed at the base. The leaf margins are smooth or more often serrated above the middle. They are shiny above, resinous with golden glands beneath, and pleasantly aromatic when crushed. Twigs are reddish brown. Small male and female flowers are borne in spring on separate plants. Fruit in the form of light-gray, wax-coated nutlets are clustered close to the stems of last year's growth. They are about 0.12 in. in diameter and remain on the shrub until eaten by wildlife.

This shrub, like a legume, has a symbiotic relationship with nitrogen-fixing bacteria on its roots. This helps it to endure on poor sites.

b. Habitat. Sunny to part shade; sandy swamps, low acid prairies, dune valleys, low woods borders.

c. Soil Requirements. Wet to moist to moderately well drained; pH 4.6 to 7.6; wet coastal plain sand and sandy soils, less frequent on acid clays.

d. Establishment and Maintenance. The easiest method for propagation is to plant the cleaned seeds in the fall. Seeds stratified for 2 months can be planted in the spring. Seeds should be planted 0.25 to 0.5 in. deep and mulched.

The bare-rooted 1-year-old nursery stock usually used for revegetation work is available commercially. Wax myrtle does not transplant easily. About a third or more of its top growth should be



A



B

Figure 27. *Myrica cerifera*, wax myrtle. A, habit; B, branches with leaves and fruits. (SCS photos)

trimmed before planting. Watering after planting will increase survival, especially on moderately well drained to well-drained sites. In group planting the spacing should be 6 to 8 ft, or in rows 4 to 6 ft apart.

Fertilize cautiously at planting time and later to ensure establishment.

e. Disease and Insect Problems. Leaf rollers which sometimes attack this shrub have recently become a serious pest along the coast of North Carolina. Control includes an insecticide spray program such as Spectricide started in early spring. Evidently even bad infestations will not kill the shrubs.

f. Wildlife Value. Medium food value; high cover value. Fruit remains on the plants for most of the winter and is eaten, usually in small quantities, by a variety of birds. Davison (1967) states that fruit is a choice food of white-eyed vireo and myrtle warbler and a fair food of bobwhite, common grackle, scrub jay, rufous-sided towhee, and red-bellied woodpecker. Van Dersal (1938) lists stomach records of 41 bird species, including ruffed grouse, bobwhite, and wild turkey. Marsh birds, shorebirds, and waterfowl also consume the fruit (Martin et al. 1951, Martin and Uhler 1951). White-tailed deer will eat the foliage and twigs.

The dense evergreen branches provide excellent nesting and roosting sites and cover for a wide range of wildlife. Many small birds, especially red-winged blackbirds, common grackles, and boat-tailed grackles, use these areas. Fish crows and as many as eight species of herons, egrets, and ibises nest and roost in wax myrtle thickets on dredged material areas along the south Atlantic and Gulf coasts. White-tailed deer, eastern cottontails, and marsh rabbits all use wax myrtle thickets for cover on dredged material sites.

g. Comments. Wax myrtle is a dominant plant on many coastal dredged material areas in the Southeast. It is an excellent landscape plant for coastal areas as well as inland (Graetz 1973). A low dwarf form, *Myrica cerifera* var. *pumila*, spreads from elongated tillers. It reaches a height of 2 to 3 ft. Single plants eventually form large colonies. Selections of this form for introduction in soil conservation work are being studied at SCS Plant Material Centers.

185. *Myrica pensylvanica* Loisel, bayberry. (Figure 28)

a. Description and Life History. A tardily deciduous, dioecious shrub to 8 ft with dark-green leaves 1.5 to 3.5 in. long and 0.5 to 1.5 in. wide. The margins often are notched toward the tips and the blade somewhat rolled inward. The leaves are aromatic when crushed. In the spring inconspicuous male and female flowers appear on separate

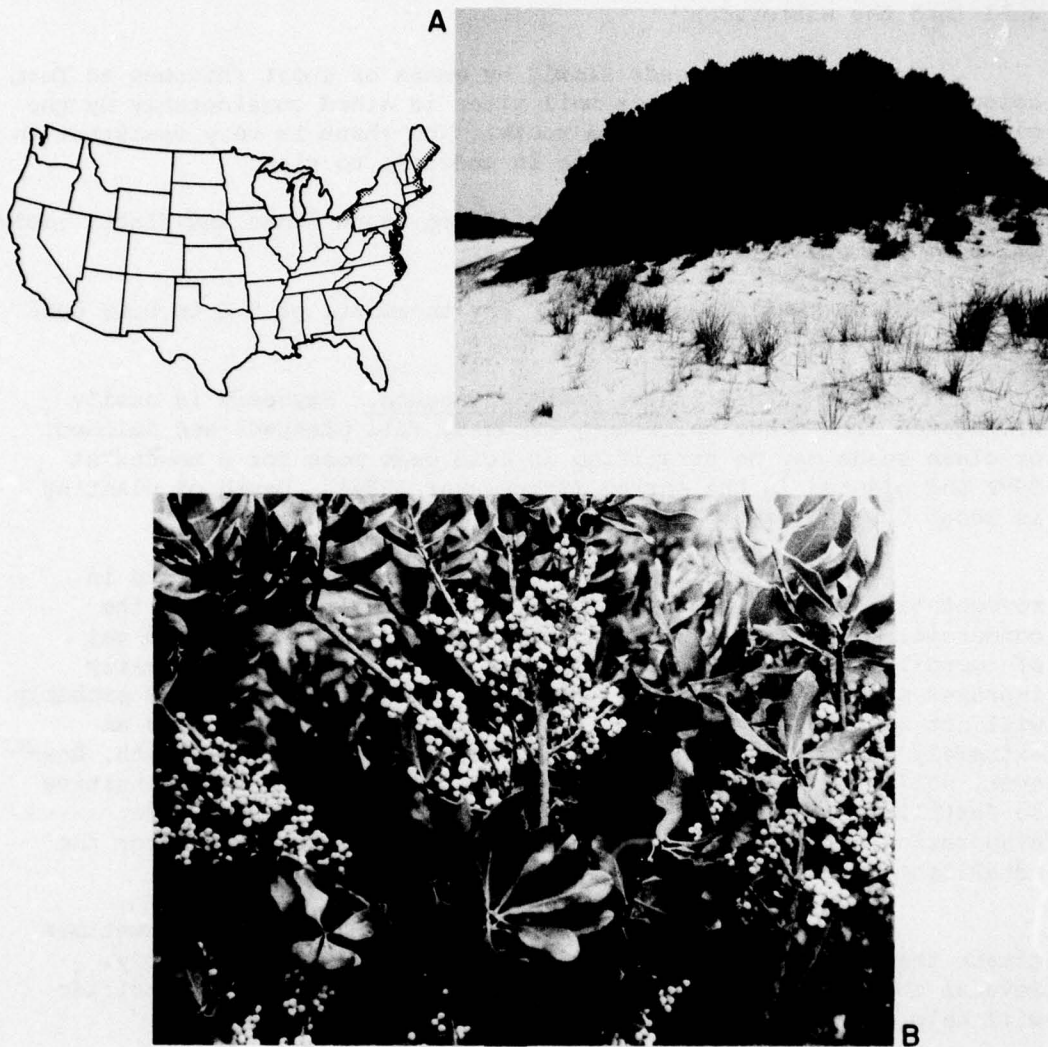


Figure 28. *Myrica pensylvanica*, bayberry. A, habit; B, branches with leaves and fruits. (SCS photos)

shrubs. Greenish-gray, wax-coated nutlets ripen in early fall. They are 0.16 in. in diameter. Nutlets are noticeably larger than those of wax myrtle and are tightly clustered on the old wood where they remain well into the winter.

Bayberry spreads slowly by means of short rhizomes to form colonies. Its growth on poor soil sites is aided considerably by the nitrogen-fixing bacteria on the roots. The shrub is very resistant to salt spray burn. The growth rate is moderate to slow.

b. Habitat. Full to half sun; sand dunes and flats, rocky hills, marsh edges.

c. Soil Requirements. Dry to moist; pH 5.6 to 8.0; dune sands, sandy soils, clay.

d. Establishment and Maintenance. Bayberry is easily propagated from seeds collected, cleaned, fall planted, and mulched, or clean seeds may be stratified in acid peat moss for 3 months at 34°F and planted in the spring (Schopmeyer 1974). Depth of planting is about 0.5 in. deep.

Bare-rooted 1- or 2-year-old nursery stock is used in revegetation work. This species may be difficult to find on the commercial market. On deep sand sites the addition of 2 to 3 gal of topsoil or a gallon of peat moss in each planting hole greatly improves survival and growth. On mixed dredged material this probably will not be necessary. The colonizing habit of this shrub is an extremely desirable characteristic. Its relatively slow growth, however, still requires a spacing of 6 ft. The plant is very sensitive to fertilizer at planting time, especially on deep sands where evaporation during dry spells can concentrate the salts. After the establishment period, spot fertilize only if needed.

e. Disease and Insect Problems. Leaf rollers sometimes attack these shrubs causing them to be disfigured and unsightly. Several applications of an insecticide such as Sevin or Spectricide will help control this pest.

f. Wildlife Value. Medium food value; high cover value. Fruit remains on the plant for much of the year and is eaten by a variety of birds. Davison (1967) states that the waxy fruit is a choice food of tree swallows and myrtle warblers and fair food of eastern bluebird, bobwhite, catbird, black-capped chickadee, yellow-shafted flicker, robin, starling, brown thrasher, hermit thrush, and red-bellied woodpecker. Van Dersal (1938) reports the fruits in stomachs of 38 bird species, including ruffed grouse, bobwhite, and ring-necked pheasant. The fruit is also eaten by marsh birds, shorebirds, and waterfowl. White-tailed deer will browse the foliage and twigs, but bayberry is not a preferred food. Because of its

thicket-forming habit and because some leaves remain on the plant most of the winter months, it provides year-round shelter for wildlife. Cover value is the same as *Myrica cerifera* above. The SCS suggests this plant as "an excellent shrub for improving food and cover conditions for farm wildlife" in the Northeast (USDA-SCS 1969-1976).

g. Comments. This plant is a dominant on dredged material areas and similar coastal areas along the North Atlantic coast. Trials with this plant on fine-textured soils in the Piedmont province of the southeast U. S. have been very successful, indicating a potentially wider use of this species for conservation problems. A natural cross of bayberry with wax myrtle has produced the variety *Myrica x macfarlanei*. This plant is a dwarf form to 3 ft which spreads to form a colony 30 ft or more in width.

The wax of bayberries is still being collected for candle-making. The leaves and berries are sometimes substituted for bay leaves in flavoring stews and soups (Vines 1960).

186. Genus *Prosopis*, mesquite. The genus *Prosopis* contains about 40 species of spiny shrubs and trees which are associated with dry to arid habitats in warmer parts of the world. The leaves are deciduous and are characterized by a stout forking midrib in the shape of a "Y"; the base of the "Y" is devoid of leaflets but the upper arms of the "Y" have numerous paired leaflets. The flowers are small and abundant. The legumes or pods are more or less cylindrical and curved, undulate, or coiled. The seeds are smooth and angled. *Prosopis* is an important fodder source for livestock and wildlife browsers and the seeds are eaten chiefly by small mammals and birds.

187. *Prosopis juliflora* (Swartz) DeCandolle, honey mesquite.
(Figure 29)

a. Description and Life History. Honey mesquite is a shrub or small tree, up to 40 ft tall, thorny, and very abundant in Texas and the Southwest. The bark is thick, brownish, and grooved. Roots may reach a depth of 60 ft. Leaflets are elliptic or linear-oblong and about 0.5 in. long. The flowers are borne on spikes and are greenish-yellow. The pods may be as much as 4 in. long, and they contain several brown, glossy seeds (Schopmeyer 1974). Honey mesquite blooms from mid-March through May and the seeds ripen from August through September.

b. Habitat. Full sun; grasslands, pastures, along ditches.

c. Soil Requirements. Moist for germination, thereafter dry to arid; pH 6.0 to 7.5; sands, sandy loams, fine-textured soils.

d. Establishment and Maintenance. Mature pods should be gathered, either from the trees or from the ground and stored in a dry place. Fumigation prior to storage will alleviate any weevil problems resulting from larvae contained in the seeds. Before planting the seeds should be soaked in concentrated sulfuric acid for 15 to 30 min, or scarified by an alternate method of placing the seeds into boiling water and allowing to cool as they soak for 24 hours. Planting times are not specified, but they are assumed to be spring or early summer. If competitors are kept under control, honey mesquite may form shrubby thickets in dry areas and quickly invade grasslands. Cut or grazed plants sprout readily from the stumps (Vines 1960).

e. Disease and Insect Problems. Mesquite is not often damaged by diseases and insects.

f. Wildlife Value. High food and cover value. Mesquite is essential to a number of wildlife species in the southwestern deserts and plains (Martin et al. 1951). The plant is used extensively by jack rabbits and Gambel quail. Van Dersal (1938) reports stomach records for five species of birds (including scaled quail and Gambel quail), coyote, hooded skunk, and jack rabbits. Other animals observed feeding on this

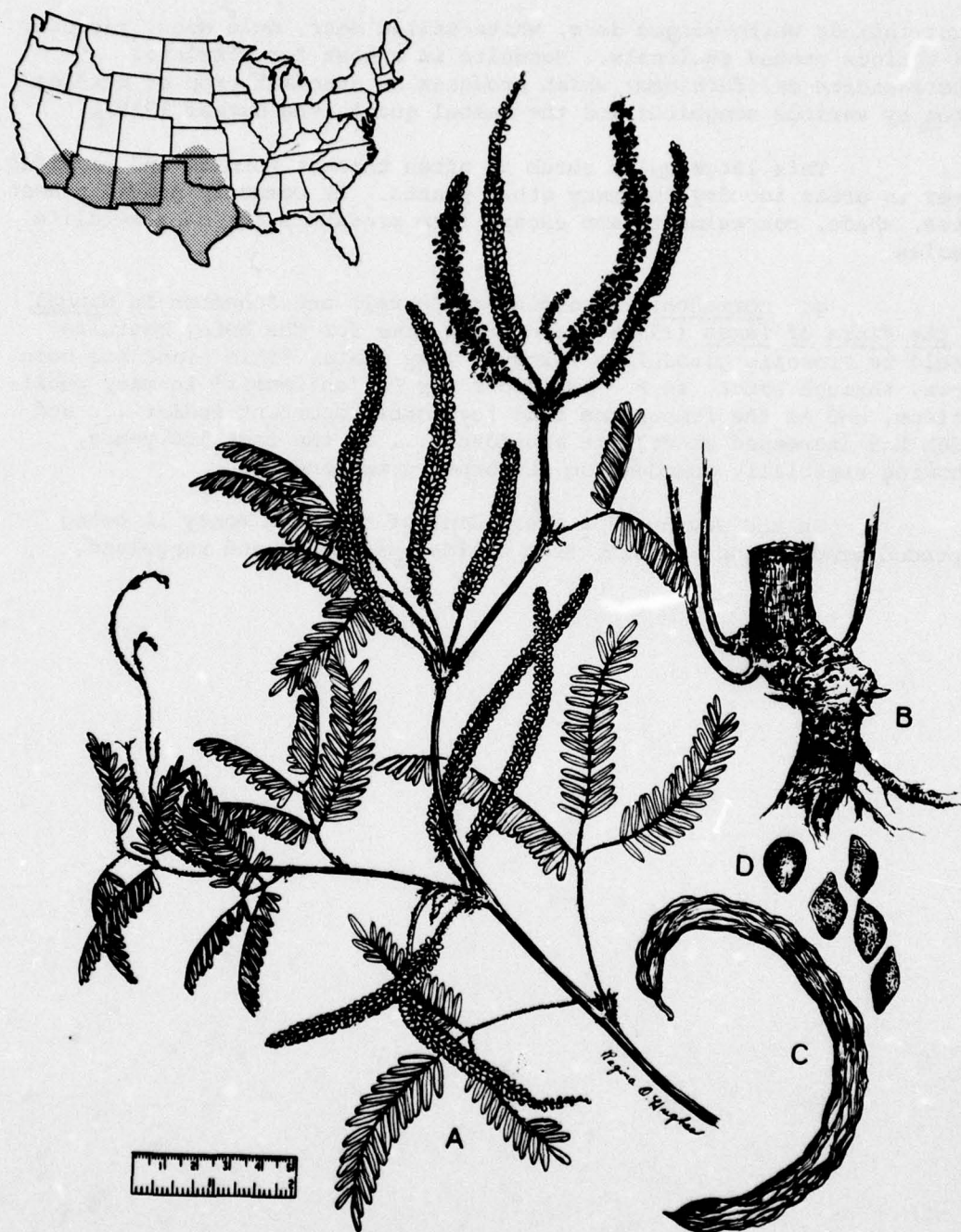


Figure 29. *Prosopis juliflora*, honey mesquite. A, habit x 0.5; B, rootstock x 0.5; C, pod x 0.5; D, seeds x 1.25.

plant include white-winged dove, white-tailed deer, mule deer, raccoon, and various ground squirrels. Mesquite is a host for mistletoe (*Phoradendron californicum*) which produces an abundant crop of berries eaten by various songbirds and the Gambel quail (Van Dersal 1938).

This large spiny shrub is often thicket forming and provides cover in areas too dry for many other plants. It commonly provides nest sites, shade, concealment, and escape from predators for many wildlife species.

g. Comments. According to Correll and Johnston in Manual of the Flora of Texas (1970) the correct name for the honey mesquite should be *Prosopis glandulosa* Torrey. They state, "This plant has been known, through error, as *P. 'juliflora'* or *P. 'chilensis'* in many publications, and is the famous one that furnishes important fodder ... and which has increased greatly in abundance ... in the last 120 years, becoming especially abundant on disturbed grasslands."

In the southwest a great deal of time and money is being expended eradicating mesquite from fields, pastures, and rangeland.

188. Genus *Prunus*, cherries, plums, and others. (See genus introduction for *Prunus* on Page 91 of the preceding Trees section.)

189. *Prunus virginiana* L., common chokecherry. (Figure 30)

a. Description and Life History. In most of its range, common chokecherry is a tall shrub. In favorable locations it becomes a small tree 20 to 30 ft high. The bark is smooth and blackish, with the inner bark not noticeably aromatic. A system of underground stems enables this plant to spread and form thickets of suckers and sprouts. Leaves are oval to elliptic, 2 to 3.5 in. long, and 1 to 2.5 in. wide. Leaf margins are finely serrated. Usually there is no pubescence along the midrib of the underside of the leaf. In the spring, small white blooms appear in elongated clusters 2 to 4 in. long. The cherries are dark red to almost black, about 0.38 in. in diameter, and juicy. They remain astringent until ripe. Each cherry has a single nut-like pit.

b. Habitat. Sun to three-fourths shade; sand dunes, rocky hills, borders of swamps, old fields, fencerows, roadsides, riverbanks, forest borders, and wooded areas to elevations of 4000 ft (Gill and Healy 1974).

c. Soil Requirements. Moist to dry; pH 5.0 to 8.0; sand, sandy soils, loam, silt, clay.

d. Establishment and Maintenance. Chokecherry is most easily propagated by seed. Because of the genetic variability of chokecherry and its wide geographic range, seeds should be collected near the area of planting to ensure local adaptability (Gill and Healy 1974). The cherries are collected in late summer when ripe. They then are cleaned and fall planted in mulched nursery beds. Seeds to be used in spring planting should be stratified in moist sand or peat for 120 to 160 days before sowing. Rate of seeding is about 25 per linear foot of row, covered with 0.5 in. of soil. A light mulch of 0.5 in. will promote germination. Larger quantities of mulch may encourage rodents to work underneath and destroy seeds.

Direct seedings should be tried in established live or dead grass cover by planting 6 or 8 seeds in fertilized "hills" opened with a hoe. In some situations a single row garden planter could be used.

Field plantings are easier to establish with 1-year-old nursery stock. The suggested spacing is 4 to 6 ft in rows and 6 to 8 ft in groups.

e. Disease and Insect Problems. Chokecherry is subject to many disease and insect attacks, notably black knot disease and defoliation by tent caterpillars. The somewhat antiseptic salt water spray keeps plants fairly "clean" in areas along the coast. The caterpillar

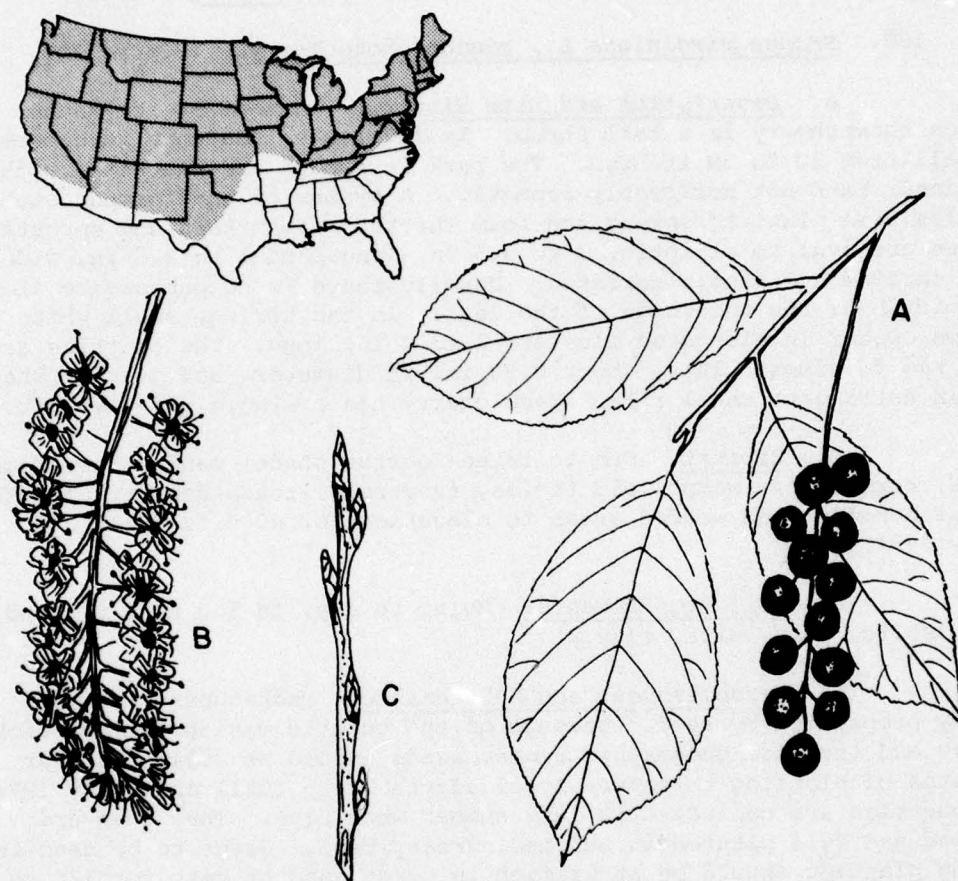


Figure 30. *Prunus virginiana*, common chokecherry. A, twig with leaves and fruits x 0.6; B, flowers x 0.6; C, twig detail x 1.

attacks are more unsightly than damaging. A burning torch on a long stick will quickly dispatch them. Usually, the plants survive and produce good crops of cherries. It does not seem practical to emphasize a spraying program for this species on dredged material.

f. Wildlife Value. High food value; medium cover value. Good crops of fruit are borne in most years; about 70 species of birds and various small mammals use the fruits (Gill and Healy 1974). Martin et al. (1951) state that wild cherries are among the most important wildlife plants and that the chokecherry is of outstanding importance. Of the wide range of wildlife mentioned by Martin et al. (1951) for the genus *Prunus*, all users within the range of the common chokecherry likely feed on this plant. Davison (1967) states that the fruit is a choice food of the eastern bluebird, evening grosbeak, rose-breasted grosbeak, ruffed grouse, sharp-tailed grouse, eastern kingbird, robin, wood thrush, pileated woodpecker, and red-headed woodpecker and is a fair food of the common crow, yellow-shafted flicker, great crested flycatcher, blue jay, ring-necked pheasant, greater prairie chicken, veery, cedar waxwing, Bohemian waxwing, and hairy woodpecker. Cotton-tail rabbits, snowshoe hares, white-tailed deer, moose, and mule deer also use this plant for food (Gill and Healy 1974).

Chokecherry provides some cover for small mammals and nesting birds, particularly where it forms thickets (Gill and Healy 1974).

g. Comments. This species is noted for its extremely wide adaptability to climate, soils, and habitat.

190. Genus *Rhamnus*, buckthorns. The buckthorn genus is composed of approximately 10 species and varieties of deciduous and evergreen shrubs and small trees. Buckthorns, uncommon in the western prairie states and desert regions, are most prevalent and of greatest importance to wildlife in the far West and Pacific region. The small, black, fleshy fruit is eaten by a variety of small mammals and birds, and the foliage is browsed by deer.

191. Species other than cascara buckthorn (*Rhamnus purshiana*) that may have value for establishment on dredged material in the West are California buckthorn (*Rhamnus californica*) and hollyleaf buckthorn (*Rhamnus crocea*).

192. The buckthorns have been used as a source for dyes, drugs, and charcoal for the manufacture of gunpowder.

193. *Rhamnus purshiana* DeCandolle, cascara buckthorn.
(Figure 31)

a. Description and Life History. A large deciduous shrub, occasionally a small tree, 6 to 20 ft tall with smooth gray or brownish bark. The dark-green, oblong or elliptic leaves, 2 to 8 in. long and 0.75 to 2.5 in. wide, are clustered on the ends of twigs. The veins on the undersides of leaves have a brownish fuzz. Leaf margins are entire or finely serrate. Numerous, small greenish flowers are borne in dense axillary clusters in April and June. The round purplish-black fruit, 0.25 to 0.5 in. in diameter, ripen from July to September.

b. Habitat. Shade to full sun; redwood and mixed evergreen forests, coastal canyons, brushy clearings, woods adjacent to coastal beaches.

c. Soil Requirements. Moist to well drained to dry; pH 6.0 to 8.0; sands, gravels, loams.

d. Establishment and Maintenance. Seeds should be collected about 2 weeks before the fruit is fully ripe and allowed to decay a few days before macerating in water to remove the pulp. Stratify the seeds for 3 months before sowing 1 in. deep during the spring (Schopmeyer 1974). Another means of propagation is by soft or hardwood cuttings made at the nodes.

d. Disease and Insect Problems. Some species are alternate or secondary hosts for oat rust, so the buckthorns and oats should not be planted in the same vicinity.

f. Wildlife Value. Medium food and cover value. The small, black, fleshy fruits which ripen in late summer are attractive to wildlife. Van Dersal (1938) reports stomach records for seven species

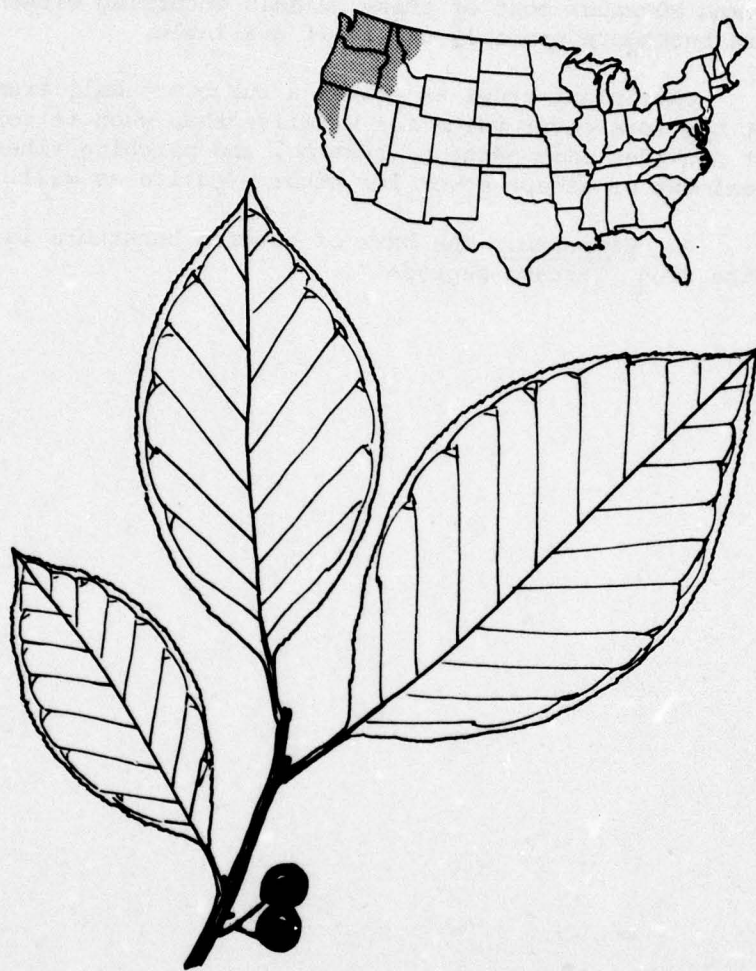


Figure 31. *Rhamnus purshiana*, cascara buckthorn. Twig with leaves and fruits x 0.5.

of birds and feeding observations of five species of birds (including the ruffed grouse and band-tailed pigeon), black bear, mule deer, gray fox, raccoon, and ring-tailed cat. Martin et al. (1951) lists 25 users of the genus *Rhamnus*; most of these animals occurring within the range of cascara buckthorn probably use it if available.

This plant grows as either a shrub or small tree. As a shrub, it has more cover value for wildlife than when it reaches tree size. It provides some nesting, resting, and perching sites for birds and concealment or escape cover for other wildlife as well.

g. Comments. The bark of cascara buckthorn is used to produce the drug "Cascara sagrada."

194. Genus *Rhus*, sumacs. The genus *Rhus* comprises about 20 species of poisonous and nonpoisonous shrubs and woody vines which characteristically grow in open, sunny habitats. Approximately 15 species are nonpoisonous. Though the toxic members, such as poison ivy (*Rhus radicans*) and poison sumac (*Rhus vernix*), have as high or higher food value than the nontoxic ones, they have not been recommended for establishment because of the potential handling difficulties for humans.

195. Several species other than the two sumacs discussed--for instance, staghorn sumac (*Rhus typhina*) and lemonade berry (*Rhus integrifolia*), have potential for use on dredged material. Before making a selection, the species which grow naturally in the vicinity of the planting should be determined.

196. *Rhus copallina* L., dwarf sumac. (Figure 32)

a. Description and Life History. A deciduous shrub or small tree with sparse lateral branching and main stems supporting an umbrella-like crown. The wide-spreading system of cable-like roots close to the surface gives rise to suckers, enabling this sumac to form thickets which are quite open underneath but which have a complete canopy above. Leaves are compound, each with 7 to 21 leaflets 1.1 to 3.1 in. long and 1 to 1.6 in. wide. The central stems of the dark, glossy green leaves are "winged" with double narrow leaf-like structures which are interrupted between sets of leaflets. Dwarf sumac is dioecious, having male and female flowers on separate plants. The cone-shaped clusters of flowers are cream colored. In the fall the female plants produce loose panicles of dark-red, hair-coated seeds at the branch tips.

b. Habitat. Sun; thickets, fencerows, old fields, marsh and woods borders, road banks.

c. Soil Requirements. Very moist to well drained; pH 4.0 to 7.0; beach sands to sandy soil, loam, silt, clay.

d. Establishment and Maintenance. Cleaned and planted sumac seeds produce strong healthy seedlings in one season. The seeds should first be scarified with concentrated sulfuric acid. The seeds are completely wetted with acid and allowed to remain wet for about 1 hr. The seed coats are then examined to determine the reduction in the thickness. A thin protective layer must remain intact. After scarification, the seeds are thoroughly flushed with water, dried, and planted (in the fall) or stratified over winter until the spring planting date.

Bare-rooted, 1-year-old nursery seedlings are usually used in field work. If small numbers of plants are needed they may be quickly established by digging up the far-ranging shallow roots,

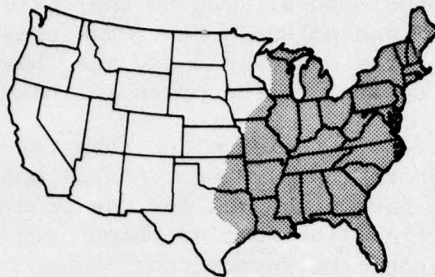


Figure 32. *Rhus copallina*, dwarf sumac. Fruiting cluster and terminal leaves. (SCS photo)

reducing them to 4- to 6-in. cuttings, and planting them on the site. The entire cutting is buried 2 to 3 in. deep and watered if possible. When planted in groups, the spacing is 6 to 8 ft.

Dwarf sumac will persist and grow on most sites without any attention.

e. Disease and Insect Problems. None.

f. Wildlife Value. High food value; low cover value. Although not a highly preferred food for wildlife, this plant is important in winter for many species. The clustered fruits ripen in the fall, persist into the winter, and are widely available when other more desirable foods are scarce (Martin et al. 1951). Davison (1967) states that the fruit is a choice food of the catbird and a fair food of the eastern bluebird, mockingbird, robin, starling, hermit thrush, wild turkey, and red-headed woodpecker. Van Dersal (1938) reports that dwarf sumac seeds were listed in stomach records of 20 species of birds including the ruffed grouse, bobwhite, sharp-tailed grouse, and lesser prairie chicken; he also reported feeding observations of ring-necked pheasants and white-tailed deer. White-tailed deer and cottontail rabbits feed on the bark and twigs as well as on the fruits.

Gill and Healy (1974) state, "Sumacs offer very little winter cover for wildlife. Because they are often the largest and most common woody plants in old fields or forest openings, they provide spring and summer wildlife cover. However, they are not important cover species and should not be established for that purpose."

g. Comments. Dwarf sumac is also called flame-leaf sumac because of its brilliant scarlet foliage in the fall. Some states are using it very successfully for landscaping road banks.

197. *Rhus glabra* L., smooth sumac. (Figure 33)

a. Description and Life History. Low-growing, deciduous shrub usually to 6 ft or less with irregular spreading branches. The twigs and branchlets are smooth and sometimes chalky. An extended root system produces sprouts that enable the plant to spread outward in a circular clone. The leaves are compound with 15 to 19 leaflets along a central axis. Leaflets are stalkless, oblong to lance shaped, 2 to 7.75 in. long, and 0.38 to 1.35 in. wide. Leaflets are serrated, green above and paler below. In the fall they turn a brilliant scarlet highlighted with yellow and orange. Flowering occurs in June and July with male and female blossoms on separate plants. In the fall, a tight pyramidal cluster of velvety red fruits ripen at the branch tips where they remain, unless eaten, until the following spring.

b. Habitat. Full sun; roadsides, waste places, old fields, edges of woods, road banks, fencerows.

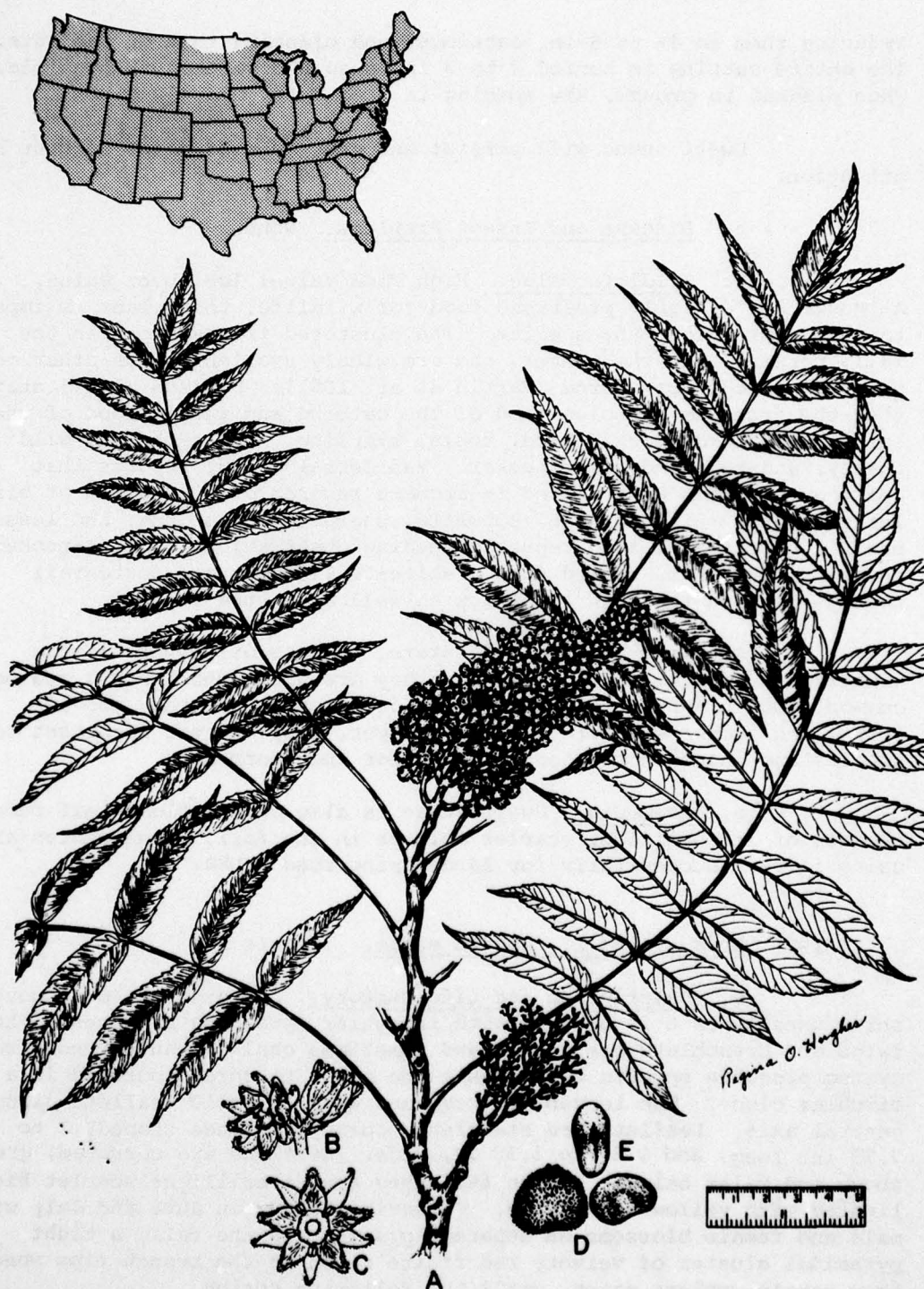


Figure 33. *Rhus glabra*, smooth sumac. A, habit x 0.5; B, flower x 5; C, diagram of flower to show disk with stamens x 6; D, fruit x 2.5; E, seeds x 2.5.

c. Soil Requirements. Moist, well drained, dry, droughty; pH 4.0 to 6.5; sandy, gravelly upland soils, eroded soils, richer silts and loams, clays.

d. Establishment and Maintenance. This species is established in the same manner as dwarf sumac (*Rhus copallina*) discussed above.

e. Disease and Insect Problems. Occasional fungi attacks have been reported from field and laboratory. However significant damage from this or insect depredation is unusual.

f. Wildlife Value. High food value; low cover value. This plant is an important winter food for many species though it is not preferred. The fruit clusters ripen in the fall, persist into the winter, and are widely available when other more desirable foods are scarce (Martin et al. 1951). Davison (1967) indicates that the fruit is a choice food of the eastern bluebird, catbird, common crow, mockingbird, and wood thrush and is a fair food of the bobwhite, purple finch, ruffed grouse, blue jay, ring-necked pheasant, greater prairie chicken, robin, starling, brown thrasher, hermit thrush, wild turkey, myrtle warbler, and red-headed woodpecker. Van Dersal (1938) reports fruits in stomachs of 32 species of birds, including the ruffed grouse, bobwhite, prairie chicken, mourning dove, and wild turkey; he reports feeding observations of seven species of birds, including the bobwhite, ring-necked pheasant, and Hungarian partridge. It is a preferred food of the wild turkey, white-tailed deer, and cottontail rabbit. Deer and rabbit feed on the bark and twigs as well as the fruits. As indicated in the preceding wildlife value discussion for dwarf sumac, smooth sumac has little cover value.

g. Comments. This species is widely planted and also occurs naturally on many road banks within its climatic range. In tests, it was found that tall fescue could survive during the summer under its canopy of approximately 80 percent shade. Thus it is possible to plant smooth sumac and tall fescue together in order to provide food and cover for a wider variety of wildlife.

198. Genus Rosa, wild roses. Wild roses are found throughout the United States in a variety of habitats ranging from swamp forests to dry, upland woods. At least 35 native species are recognized, and many cultivated species have been planted. Hybrids are frequently formed where ranges coincide, making identification difficult in some instances. Though some species are found in shaded habitats, growth is more vigorous and fruit more abundant on specimens established in full sun. Compound leaves, stems with prickles, and distinctive fruits, called hips, are characteristic of the genus. Both the hips and the foliage are used by wildlife. The Carolina rose (*Rosa carolina*), discussed below, is the most widely distributed species in the East. Other species, such as the swamp rose (*Rosa palustris*) and rugosa rose (*Rosa rugosa*), may also be suitable for wildlife habitat development.

199. Rosa carolina, L., Carolina rose. (Figure 34)

a. Description and Life History. A deciduous, stoloniferous, erect shrub to 3 ft tall. The green to reddish stems are armed with slender, needle-like prickles. The bark on the lower portions of the plant is green or green with gray areas. The compound leaves are commonly made up of five elliptic or egg-shaped leaflets which are 0.75 to 1.25 in. long and half as wide. The leaflets have sharply toothed margins and are dull green above and paler and sometimes hairy on the underside. Solitary pink flowers about 2 in. across appear from May to July. The small, dark-red, applelike hips are about 0.3 in. in diameter. They ripen from August to October and remain on the plant through the winter.

b. Habitat. Light shade to full sun; upland pastures and fields, dry open woods, thickets, pine forests, woodland borders.

c. Soil Requirements. Well drained to dry; pH 4.5 to 7.0; sandy and rocky soils, sandy loams.

d. Establishment and Maintenance. To grow Carolina rose from seeds, the hips can be picked as soon as they turn red. Seeds gathered soon after the hips ripen germinate more readily than those collected after the hip has dried out. To clean the seeds, macerate the hips in water and remove pulp. Cleaned seeds may be sown immediately in the fall before they dry out, or may be stratified for 3 months at 35° to 40°F and planted in the spring (N. C. Wild Flower Preservation Society, Inc. 1977).

Carolina rose also can be propagated by cuttings. Softwood cuttings 6 to 7 in. long can be taken in spring or early summer. Select a stem that has just flowered and remove the immature fruit and the basal leaves (N. C. Wild Flower Preservation Society, Inc. 1977). Plant cuttings 3 in. deep and keep moist and shaded until roots form. Shade should be gradually removed over a 2-week period to prevent sun

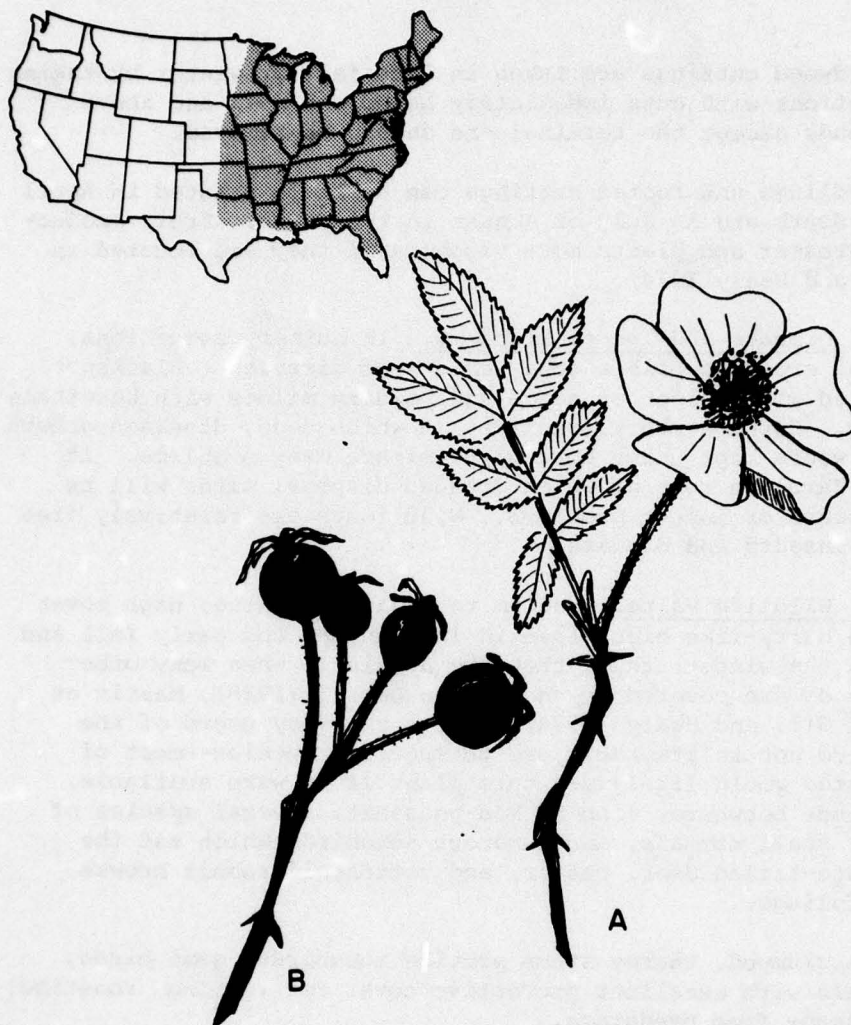


Figure 34. *Rosa carolina*, Carolina rose. A, twig with leaves and flowers x 1; B, fruits x 1.

scorching. Hardwood cuttings are taken in late fall or winter by taking 6- to 8-in. sections with cuts immediately below one node and above another. All buds except the terminal one should be removed.

Seedlings and rooted cuttings can be field planted in April and May in the South and in July or August in the North. Fruit productions will be greater and plants more vigorous if they are located in full sun (Gill and Healy 1974).

e. Disease and Insect Problems. In nursery situations, roses in general are susceptible to a variety of diseases. Blackspot can be controlled with folpet or maneb and powdery mildew with Karathane or folpet spray. Sound nursery practices in which dead, diseased growth is removed and weeds kept under control eliminate many problems. It is doubtful if Carolina rose grown on dredged disposal sites will be bothered by disease or insect problems. Wild roses are relatively free from attack by insects and disease.

f. Wildlife Value. Medium to high food value; high cover value. The red berry-like hips ripen in late summer and early fall and persist through the winter; thus, they are available when many other fruits are gone or are covered by snow. Van Dersal (1938), Martin et al. (1951), and Gill and Healy (1974) discuss the many users of the genus *Rosa* but do not relate their use to specific species--most of the animals listed would likely use this plant if it were available. Such users include bobwhite, ring-necked pheasant, several species of grouse, various small mammals, and numerous songbirds which eat the fruits, and white-tailed deer, beaver, and cottontail rabbit browse the stems and foliage.

The clumped, thorny stems provide songbirds, game birds, and small mammals with excellent protective cover for resting, roosting, nesting, and escape from predators.

200. *Rosa multiflora* Thunberg, multiflora rose. (Figure 35)

a. Description and Life History. A cultivated, deciduous shrub to 10 ft with many branched, arching, or trailing stems. The stems or canes are usually armed with many strong, hooked thorns. The bark of older stems is brown to gray; young twigs are reddish green to red in winter. The compound leaves are normally composed of 9 elliptic to ovate leaflets, each 0.5 to 1.5 in. in length. The undersides of the leaflets are paler than the surface and covered with short hairs. The fine teeth along the leaflet margin are red tipped. Pyramidal clusters of fragrant white flowers, 0.75 to 1.6 in. wide, bloom in May and June. Red or reddish-orange ovoid hips (the fruit), 0.25 to 0.4 in. in diameter, ripen in September and August and remain on the branches until spring.



Figure 35. *Rosa multiflora*, multiflora rose. A, habit x 0.5; B, leaf base x 2; C, bud x 2; D, styles and stamens x 2; E, fruits x 0.5; F, achenes x 2.

b. Habitat. Full sun; along fences, pastures, woodland borders, thickets, ornamental hedge rows.

c. Soil Requirements. Moist to well drained to dry; pH 5.0 to 7.0; moderately to highly fertile sandy soils, sandy loams, clay-loams, clay soils. "As a rule, aggressive spreading is commonest on soils high in lime" (USDA-SCS 1969-1976).

d. Establishment and Maintenance. Multiflora rose seeds and planting stock are commercially available. Methods for collecting, treating, and planting seeds are the same as given for Carolina rose. However, stratification of multiflora rose seeds for 1 month rather than 3 may be sufficient. Techniques for taking cuttings are also the same for the Carolina rose and multiflora rose.

To prepare a site for planting seedlings or rooted cuttings, all competing plants, grasses, weeds, woody plants, etc., should be removed. Before planting, sites should be plowed, harrowed, and allowed to settle. Set plants up to the root crown in plowed furrows or individual holes. The soil must be well compacted around the roots. For hedges, plants are spaced 6 to 18 in. apart. Rows should be at least 10 ft apart. Spacing for clumped plantings is 10 ft. The recommended fertilization rate is 1 lb of 5-10-5 per 40-ft row. Use of poultry manure is also recommended. It is necessary to control weedy competition to ensure satisfactory establishment. Mulching plants or cultivating around them until they are about 2 ft tall is very advantageous (USDA-SCS 1969-1976). Plant stock in full sun for maximum fruit production.

e. Disease and Insect Problems. See information given for Carolina rose.

f. Wildlife Value. Medium to high food value; high cover value. The red, fleshy, berry-like hips ripen in late summer and early fall and persist through the winter; thus they are available when many other fruits are gone or are covered by snow. Van Dersal (1938), Martin et al. (1951), and Gill and Healy (1974) discuss the many users of the genus *Rosa*, but do not relate their use to specific species. However, most of the users listed would likely use multiflora rose if available. Robertson (1973), in his in-depth thesis study of autumn olive and multiflora rose, presents a literature review and lists 41 wildlife species observed utilizing multiflora rose. He lists 34 species of birds (including the bobwhite, mourning dove, and wild turkey), the eastern cottontail, gray fox, red fox, white-tailed deer, woodchuck, white-footed mouse, and short-tailed shrew. Davison (1967) states that the fruit is a choice food of the mockingbird and cedar waxwing and a fair food of the eastern bluebird, cardinal, American goldfinch, evening grosbeak, ruffed grouse, slate-colored junco, ring-necked pheasant, greater prairie chicken, robin, fox sparrow, song sparrow, tree sparrow, brown thrasher, and wild turkey.

Often planted in hedgerows, the multiflora rose has drooping, thorny stems which form excellent year-round protective cover used by many songbirds, game birds, and small mammals for escape from predators or for resting, roosting, or nesting sites.

g. Comments. The use of multiflora rose has been and continues to be debated by various individuals in botanical, soil conservation, agricultural, and wildlife management fields. Even though the wildlife value of multiflora rose has been demonstrated, the species' spreading tendencies make its use in certain areas undesirable (Robertson 1973, USDA-SCS 1969-1976). In some parts of the country multiflora rose has become a pest (primarily to agricultural interests) and efforts are made to eradicate it. Before using this species for wildlife habitat development, habitat managers should investigate its status and potential in the particular area; state wildlife agencies, SCS personnel, and local biologists may offer guidance.

201. Genus Rubus, blackberries. The genus *Rubus* contains a large, undetermined number of species of blackberries, dewberries, and raspberries. These semiwoody shrubs are extremely variable and difficult to classify; they are hardy, abundant, and tolerant of a wide range of ecological conditions. Use by wildlife, as well as humans, is well documented.

202. The species listed below for tentative use on dredged material areas were selected either for their distribution or for their known occurrence on dredged material. However, many additional species, especially those already growing on or in the general vicinity of disposal sites, may be just as suitable, or more so, for habitat establishment.

203. *Rubus allegheniensis* Porter, Allegheny blackberry.
(Figure 36)

a. Description and Life History. An erect or arching high-bush blackberry with a perennial base and biennial stems to 10 ft. Prickles on the stems are separated, spreading at right angles from the stems, and rarely recurving. The leaves consist of five leaflets that are softly pubescent beneath; the terminal leaflet is ovate-oblong, 4 to 8 in. long and acuminate; lateral leaflets are smaller. The flowers, which appear in May and June, are in slightly compacted inflorescences, less than three times as long as wide. Flowers are white and to 1 in. across; sepals are acute to short-caudate; and petals are separate and cuneate. Fruits, consisting of 50 or more individual drupelets, are deep violet, oblong to conic in shape, and an inch or more long. They ripen in early summer.

Soon after frost, shoots appear from the perennial root-stocks. The first-year shoots are sterile and vegetatively robust; less vegetative growth occurs the second year and flowers appear. The weight of the ripening fruit, together with inherent weakness of the stem, forces the stem to arch, often becoming entangled with new first-year stems and thus forming mound-like clones with exceptional wildlife food and cover value.

b. Habitat. Full to partial sun; open places in woodlands, roadsides, old fields, fencerows, pastures, clearings; dry slopes to moist bottomlands.

c. Soil Requirements. Moist; pH 4.5 to 7.0; deep sandy soil with abundant humus is optimum, other soil types tolerated.

d. Establishment and Maintenance. Fruits should be picked by hand as soon as ripe to reduce losses to birds and other animals. The seeds need to be cleaned and soaked in concentrated sulfuric acid.

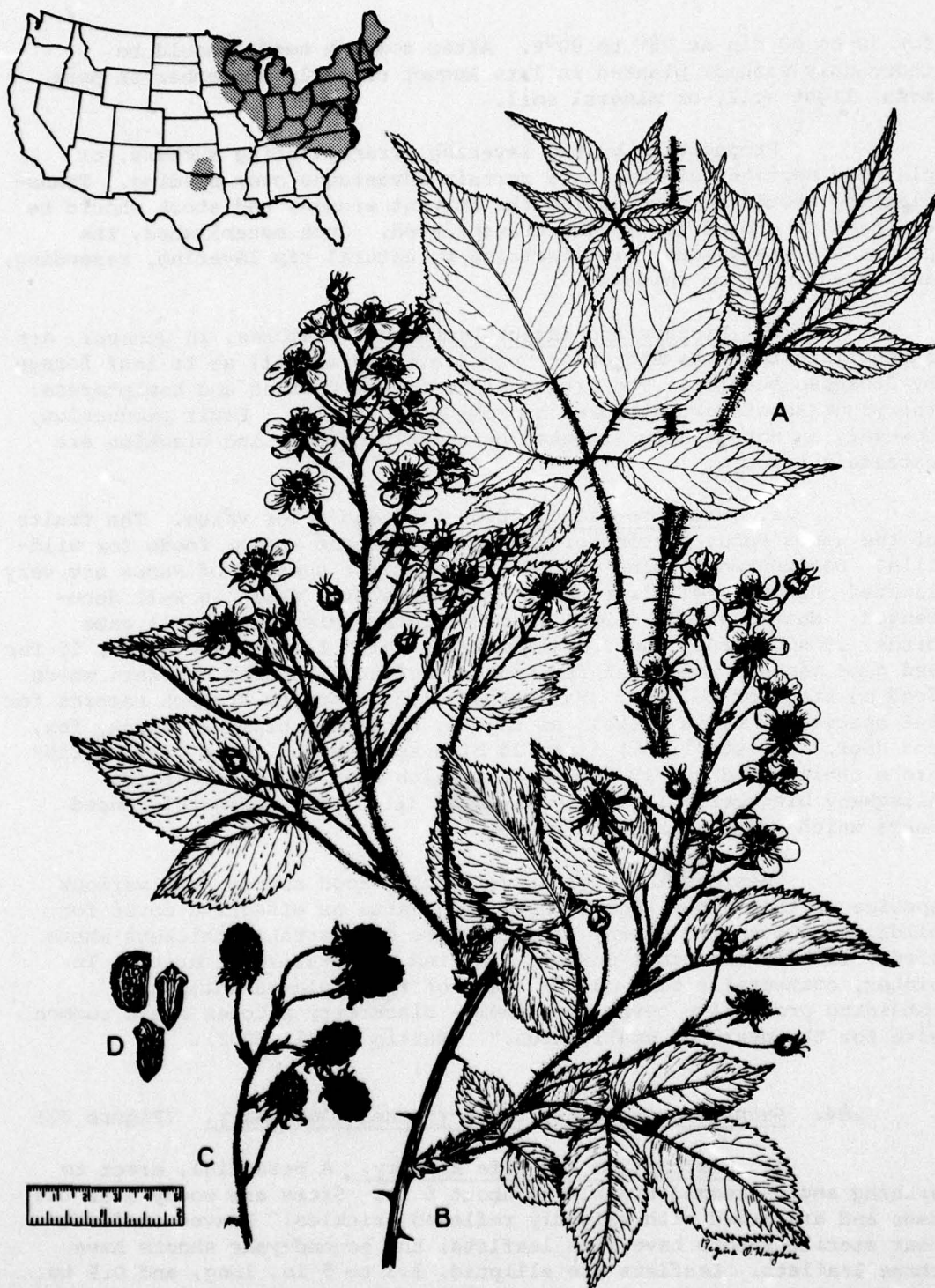


Figure 36. *Rubus allegheniensis*, Allegheny blackberry. A, primocane habit x 0.5; B, floricane habit x 0.5; C, fruit showing drupelets x 0.5; D, seeds x 3.

for 50 to 60 min at 75° to 80°F. After soaking seeds should be thoroughly washed; planted in late August or early September in peat moss, light soil, or mineral soil.

Propagation by tip layering, transplanting suckers, or planting sections of root have certain advantages over seeding. Transplanting should be done during the dormant season, and stock should be cut back to ground level when transplanted. Once established, the plants are gregarious, proliferating by natural tip layering, reseeding, and sprouting from rhizomes.

e. Disease and Insect Problems. Brambles, in general, are susceptible to rusts and other fungal attacks as well as to leaf forage by Japanese beetles. The fruits are eaten by beetles and hemipterans; the young shoots are attacked by aphids and scales. Fruit production, however, is not greatly affected by these problems, and brambles are extremely hardy.

f. Wildlife Value. High food and cover value. The fruits of the genus *Rubus* are one of the most important summer foods for wildlife. Documented feeding records for specific species of *Rubus* are very limited; however, wildlife use of the genus as a whole is well documented. Martin et al. (1951) list 97 users--this includes 11 game birds, 55 songbirds, and 7 small mammals which feed on the fruit; 15 fur and game mammals which eat fruit or stems; and 6 hoofed browsers which feed on stems or foliage. Van Dersal (1938) reports stomach records for 146 species of birds as well as coyote, opossum, chipmunk, skunk, fox, and deer. Davison (1967) lists 34 bird species for which blackberries are a choice food and 17 species for which they are a fair food. Allegheny blackberry is likely eaten by all of the above-referenced users which occur within its range.

"Besides their great value as a food source, the various species of this group [*Rubus*] have much value as effective cover for wildlife. Often the thorny brambles make impenetrable thickets where birds, rabbits and other animals can find comparative security. In winter, cottontails feed on the stems of these plants while also obtaining protective cover from them. Blackberry patches are a common site for the nests of small birds." (Martin et al. 1951).

204. *Rubus argutus* Link, sharp-toothed blackberry. (Figure 37)

a. Description and Life History. A perennial, erect to arching angle-stemmed bramble to about 6 ft. Stems are woody near the base and are armed with slightly reflexed prickles. Leaves on first-year sterile shoots have five leaflets; the second-year shoots have three leaflets. Leaflets are elliptic, 1.3 to 5 in. long, and 0.5 to 2.5 in. wide. Leaf margins are toothed. The apex is pointed and the undersurface is smooth or soft to the touch. Flowers, usually

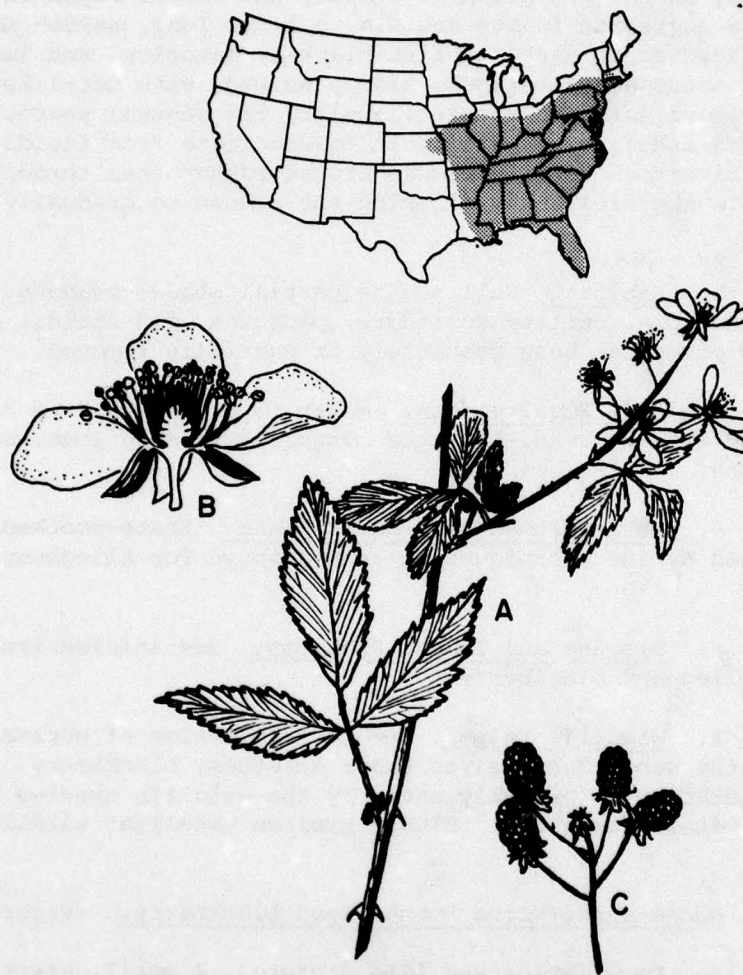


Figure 37. *Rubus argutus*, sharp-toothed blackberry. A, branch with leaves and flowers x 0.5; B, flower x 1.5; C, fruits x 0.3.

terminating the second-year stems, are numerous and are often arranged in a flat-topped cluster. The petals are white and about 1 in. long; sepals are sharp pointed and densely pubescent. The plant blooms in April and May in the mid-Atlantic states, and fruits ripen in mid-summer. The aggregate fruits are 0.4 to 1 in. long, seldom more than 0.5 in. broad, red to dark purplish-black at maturity, and juicy and sweet. The seeds are flattened, kidney shaped, with net-like ridges; they have a hard wall and retain viability for several years. The root is long lived and is often difficult to eradicate from fields and pastures. Livestock usually browse around rather than through the clumps of blackberries, thus allowing the plants to gradually increase in size.

b. Habitat. Full sun to partial shade; meadows, woodland borders, fencerows, utility corridors, pastures, old fields, other areas where cover has been completely or partially removed.

c. Soil Requirements. Moist to dry; pH 5.5 to 7.0; often in infertile eroded areas, but more luxuriant in deep loam, well-drained sites.

d. Establishment and Maintenance. Sharp-toothed blackberry is propagated by the techniques discussed above for Allegheny blackberry.

e. Disease and Insect Problems. See information given above for Allegheny blackberry.

f. Wildlife Value. See the discussion of general wildlife values for the genus *Rubus* given under Allegheny blackberry. Sharp-toothed blackberry is probably eaten by the wildlife species mentioned that occur within its range. Clumps provide excellent wildlife cover.

205. *Rubus cuneifolius* Pursh, sand blackberry. (Figure 38)

a. Description and Life History. A small, erect to arching blackberry. The leaves have dark-green upper surfaces and grayish to white lower surfaces. Stems are heavily armed with slightly recurved prickles, extending to and becoming more reflexed on leaf petioles. Young angled stems are downy pubescent; older stems are smooth, or with infrequent long, twisted hairs. Like other blackberries, sand blackberry produces biennial stems; first-year stem leaves have five leaflets, second-year stem leaves have three. On second-year stems the flowers are borne either terminally or on stout lateral branches. Flowers are numerous, white, about 1 in. wide. Fruits are elongate 0.5 to 0.8 in. long and 0.5 in. in diameter; they are sweet, but less juicy than most species. Sand blackberry blooms from late April to early June; fruits ripen in midsummer. Seeds are flattened and rough textured.

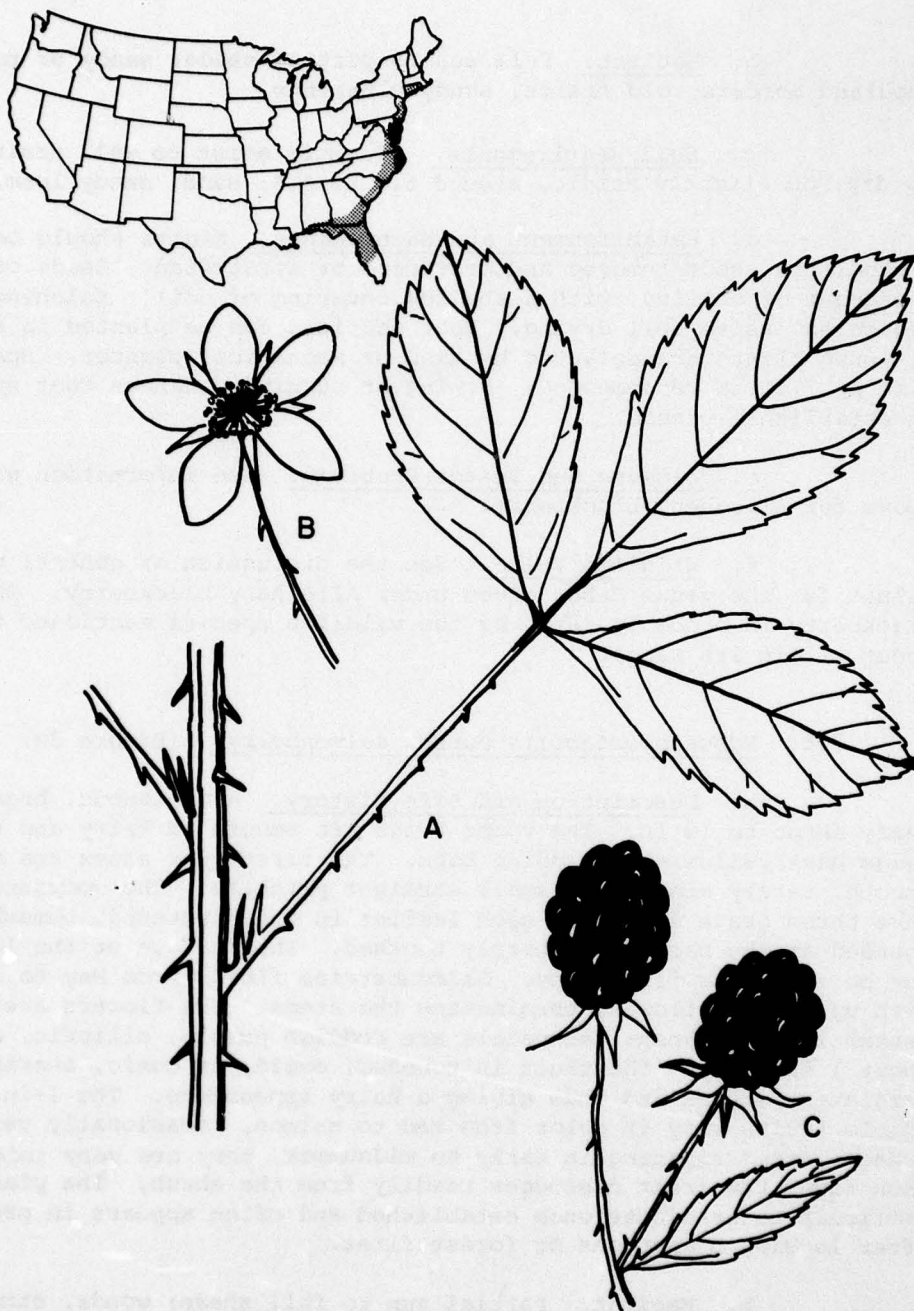


Figure 38. *Rubus cuneifolius*, sand blackberry. A, branch with leaf x 1; B, flower x 1.3; C, fruit x 1.

b. Habitat. Full sun to partial shade; sandy or rocky woodland borders, old fields, sandy clearings.

c. Soil Requirements. Slightly moist to well drained to dry; pH slightly acidic, around 6.0 to 6.5; sand, sandy loam.

d. Establishment and Maintenance. Fruits should be hand picked, the seeds removed and scarified or stratified. Seeds can be broadcast or drilled, with a shallow covering of soil. Mulching will reduce excessive soil drying. Root sections can be planted in trenches, or young plants transplanted by hand or mechanical planter. Spacing of 6 ft by 7 ft is recommended. Mowing or burning enhances root sprouting in established stands.

e. Disease and Insect Problems. See information given above for Allegheny blackberry.

f. Wildlife Value. See the discussion of general wildlife values for the genus *Rubus* given under Allegheny blackberry. Sand blackberry is probably eaten by the wildlife species mentioned that occur within its range.

206. *Rubus spectabilis* Pursh, salmonberry. (Figure 39)

a. Description and Life History. A deciduous, branching, leafy shrub to 15 ft. The young twigs are smooth to hairy and the older twigs have yellowish shredding bark. The first-year stems are mostly smooth, rarely armed with small straight prickles. The compound leaves have three ovate leaflets; each leaflet is thin textured, somewhat rounded at the base, and sharply toothed. The surface of the leaflets may be smooth or fine-downy. Salmonberries flower from May to June with up to four flowers terminating the stems. The flowers are ornamental in appearance; the petals are reddish purple, elliptic, and about 1 in. long. The fruit is rounded, ovoid, or conic, bearing persistent styles and thus giving a hairy appearance. The 1-in.-long edible fruits vary in color from red to salmon, occasionally yellowish orange; after ripening in early to midsummer, they are very juicy. When ripe, the fruit dislodges readily from the shrub. The plant is difficult to eradicate once established and often appears in profusion after logging operations or forest fires.

b. Habitat. Partial sun to full shade; woods, stream banks, ravines, disturbed slopes.

c. Soil Requirements. Moist; acidic; gravelly to loamy or sandy well-drained soils.

d. Establishment and Maintenance. Seeds can be separated from the pulp by soaking the fruits in water, gently macerating the

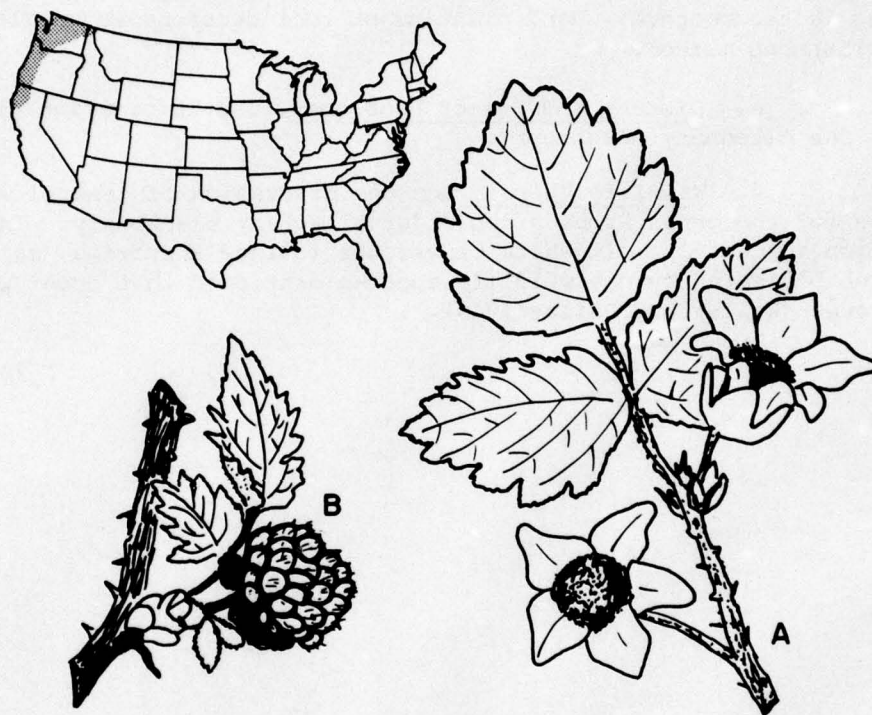


Figure 39. *Rubus spectabilis*, salmonberry. A, twig with leaf and flowers x 1, B, fruit x 1.

mixture, and floating out the pulp and aborted seeds. Sound seeds will settle to the bottom of the container. Cleaned seeds should be dried before storage to prevent mildew and may be kept at 41°F in a refrigerator. To speed up germination the hard seed coat must be scarified with sulfuric acid for 20 to 60 min. Warm temperature (68°F) stratification followed by cold stratification (36° to 41°F) will also give the same results as scarification. Pretreated seeds should probably be tested in sand or in a germinator for 30 to 60 days to determine whether treatment has been adequate. Early fall or spring sowing is recommended. Hand planting of root sections is an alternate establishment method.

e. Disease and Insect Problems. See information given above for Allegheny blackberry.

f. Wildlife Value. See the discussion of general wildlife values for the genus *Rubus* given under Allegheny blackberry. In addition to deer and elk which browse the foliage and twigs, salmonberry is probably eaten by the wildlife species mentioned that occur within its range (Bailey and Bailey 1949).

207. Genus Salix, willows. The genus *Salix* is a widespread group of 300 or more taxonomically difficult trees and shrubs; they occur mostly along stream banks and pond margins, chiefly in the northern temperate, boreal, and arctic zones. These woody plants are noted for their generally rapid growth, poor wood quality, and persistent weediness. They often become a nuisance around wells, ditches, and drainage pipes.

208. Because willows are predominantly wetland or water-land interface plants, their versatility for terrestrial habitat development is limited. The two species discussed on the following pages are representative of the genus as a whole and need not be the choice species for propagation in certain areas. In view of the general abundance and widespread nature of the genus, other species may be as adaptable and more readily available depending upon the dredged material location and site development plans.

209. *Salix hookeriana* Barratt, Hooker's willow. (Figure 40)

a. Description and Life History. A large deciduous shrub or small tree with a maximum height of about 30 ft. Leaves are dark green above, woolly on the undersurface, ovate to broadly obovate, 1.5 to 3 in. long and 0.7 to 2 in. wide. Leaf tips are rounded or bluntly pointed with bases rounded, and margin teeth absent or inconspicuous. Stems readily form adventitious roots when buried or flooded. The twigs are densely woolly for the first 2 or 3 years, gradually becoming hairless and exposing reddish-brown bark. Older bark is gray and can be rough or smooth. Buds are dark brown to reddish brown and hairy. As with all willows, the flowers are arranged in male and female catkins, usually appearing just before the leaves emerge from the buds. The catkins are 3 to 4 in. long and about 0.5 in. wide. Seed capsules are elongated and hairless; the seeds, ripening in mid-June to July, are minute and are dispersed mostly by wind or water. Hooker's willow can survive partial burial by drifting sand and can also tolerate flooding.

b. Habitat. Full to partial sun; mouths of rivers, lagoons, on coastal dunes and ridges, meadows, dune depressions.

c. Soil Requirements. Wet to moist; occasionally found on dry sites; pH 5.6 to 7.0; medium to coarse-grained deep sands that are generally mineral deficient.

d. Establishment and Maintenance. The small size of the seeds and the ease with which Hooker's willow can be propagated by cuttings favor vegetative propagation. Cuttings can be treated with a commercially available growth hormone and layered in moist sand for several weeks until roots develop. Seedlings thus acquired can be planted by hand or machine in trenches or rows with 3 ft by 3 ft



Figure 40. *Salix hookeriana*, Hooker's willow. A, twig with leaves and fruit x 1; B, female catkin x 1; C, male catkin x 1.

or greater spacing. Young plants grow rapidly and reach maximum height in about 5 to 10 years.

On moist sites, 12- to 16-in. cuttings can be planted directly on the site. A planting bar is used to open holes which will leave only 3 or 4 in. of the cutting exposed.

e. Disease and Insect Problems. None.

f. Wildlife Value. Low to medium food value; high cover value. No information on the use of this species was noted. However, based both on the users of the genus *Salix* which are listed in Martin et al. (1951), Van Dersal (1938), and other references and on the wildlife species which occur within the range of this species, the buds, foliage, or bark of Hooker's willow is likely eaten by such important fur or game animals as the mule deer, white-tailed deer, beaver, snowshoe hare, brush rabbit, and ruffed grouse.

Because of their abundance and thicket-forming habits, willows provide cover and protection for many birds and mammals. Willows provide nesting sites for waterfowl, wading birds, and land birds and valuable brood cover for some ducks (Gill and Healy 1974).

g. Comments. Hooker's willow is subject to girdling by browsers, and such damage can result in death of the plant.

210. *Salix interior* Rowlee, sandbar willow. (Figure 41)

a. Description and Life History. A gregarious, monoecious, deciduous small shrub or tree, spreading by runners and forming dense thickets. The sandbar willow attains a maximum height of about 15 ft but is usually observed in patches of 3- to 10-ft-high plants. Twigs are greenish brown to reddish brown. Leaves are linear to narrowly lanceolate (on new shoots oblanceolate) with a long tapered apex and a short tapered base. The blades are 2 to 6 in. long and about 0.3 in. wide at maturity. Leaves are soft-hairy particularly when young. The teeth along the margins are widely spaced. Flowers are clustered in catkins which appear after the leaves have emerged from the buds. The male flowers are mostly in terminal or axillary densely crowded catkins with yellowish scales. Female flowers are loosely arranged, mostly in axillary catkins. The young fruit has long white silky hairs which may or may not be lost when the fruit matures in April. The seeds are minute and attached to long white wind-buoyant hairs.

b. Habitat. Full sun; beaches, shorelines, river bars, sandy clearings near water.

c. Soil Requirements. Moist to wet; pH 5.0 to 6.5; medium-grained sands, sandy silts, loams.

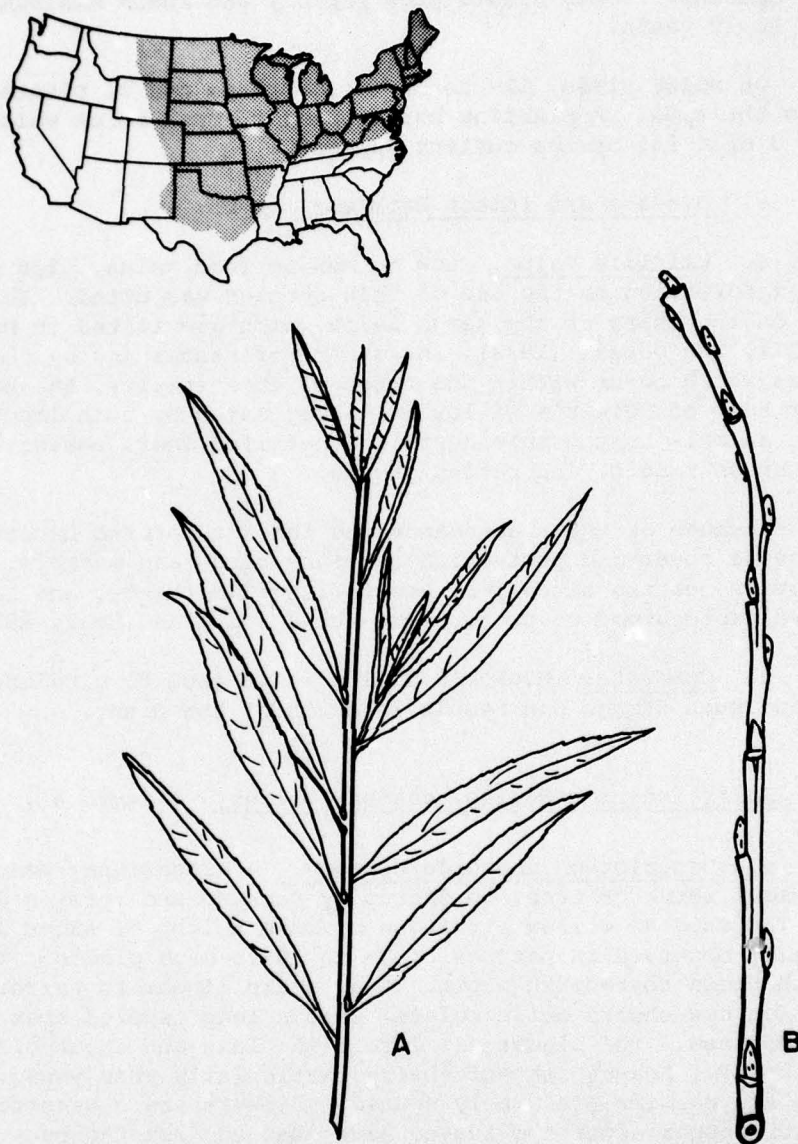


Figure 41. *Salix interior*, sandbar willow. A, twig with leaves x 1; B, twig detail x 1.

d. Establishment and Maintenance. Willow seeds must be collected just before the fruits (capsules) open; therefore, the collection time is fairly limited. Seeds are viable for only a few days, and commercial supplies are not available. Viability may be prolonged by stratifying the seeds. Light is required for germination. For site plantings, seeds must be sown immediately after harvest by broadcasting the seed-capsule mixture and rolling lightly. Seedlings can be transplanted about 4 weeks from time of sowing. A simpler method for selecting planting stock consists of removal of young plants from natural populations since they are typically found in willow brakes. Cuttings 12 to 16 in. long can be planted directly on the site if the soil is moist. Only a few inches of the tops are left uncovered.

e. Disease and Insect Problems. None.

f. Wildlife Value. Low to medium food value; high cover value. Van Dersal (1938) reports an observation of white-tailed deer feeding on this plant; however, other documented use is lacking. Based on documented wildlife use of the genus *Salix* (Martin et al. 1951, Van Dersal 1938, Davison 1967) and on the distribution of the sandbar willow, this species is likely used by a number of important wildlife species. The white-tailed deer, eastern cottontail, swamp rabbit, beaver, and ruffed grouse are probable users which occur on dredged material areas within the sandbar willow's range.

Because of their abundance and thicket-forming habits, willows provide cover and protection for many birds and mammals. Streamside willows provide nesting sites for waterfowl, wading birds, and land birds and valuable brood cover for some ducks (Gill and Healy 1974).

211. Genus *Sambucus*, elderberries. The dozen or so elderberries in the country are generally confined to moist, fertile soils. All have opposite compound leaves, pithy twigs, and dense clusters of small white to cream flowers. Blue, black, purple, or red berries are produced in abundance. Though the dark berries are used for making wine, pies, and preserves, red fruit characteristic of certain species are reportedly poisonous to humans (Bailey and Bailey 1949). The two species selected for discussion are considered by Martin et al. (1951) to have the greatest wildlife value. However, other species may be equally suitable for establishment, and local species should be considered during the selection process.

212. *Sambucus caerulea* Rafinesque, blue elderberry. (Figure 42)

a. Description and Life History. A deciduous, many-stemmed shrub to 6 to 10 ft or small tree to 25 ft. The bark is dark brown to reddish. The opposite compound leaves are composed of 5 to 9 oblong to ovate leaflets, each 1 to 6 in. long and 0.5 to 2 in. wide. Leaflet bases are asymmetrical; the margins are evenly toothed. The upper surface of the leaflets is dark green, the lower is paler. The size, shape and amount of hair on the leaflets are quite variable for this species. Small white flowers approximately 0.25 in. wide form dense flat-topped clusters up to 10 in. across. Flowering occurs from April to September. The edible berries which follow are approximately 0.25 in. in diameter and are blue to black with a whitish coating.

b. Habitat. Partial shade to full sun; open disturbed areas, woodland margins, moist sites in coastal and interior valleys and coastal mountains, mountain coniferous forests.

c. Soil Requirements. Moist to well drained to dry; pH 5.5 to 7.5; tolerates a wide range of soil conditions.

d. Establishment and Maintenance. Seeds should be collected as soon as ripe to reduce losses to birds. Clean by macerating fruit with water to remove the pulp; if the fruit is crushed and dried, no further cleaning is necessary. Seeds may be planted in the fall or stratified and sown in spring. Usually germination does not occur until the second spring regardless of season of planting. One nursery method that has proven successful is to soak dried seeds in water for 3 days, then stratify in vermiculite for 3 months at 34°F prior to spring planting. Seeds are sown 0.25 in. deep at a rate of 35 to 40 per foot and are covered with a sawdust mulch about 0.38 in. deep. Usually 1-year-old seedlings are large enough for field planting. Plant in full sun for maximum fruit production.

Though no specific information for propagating blue elderberry from cuttings was found, the techniques given for American elderberry (*Sambucus canadensis*), the species which follows, would probably be successful.

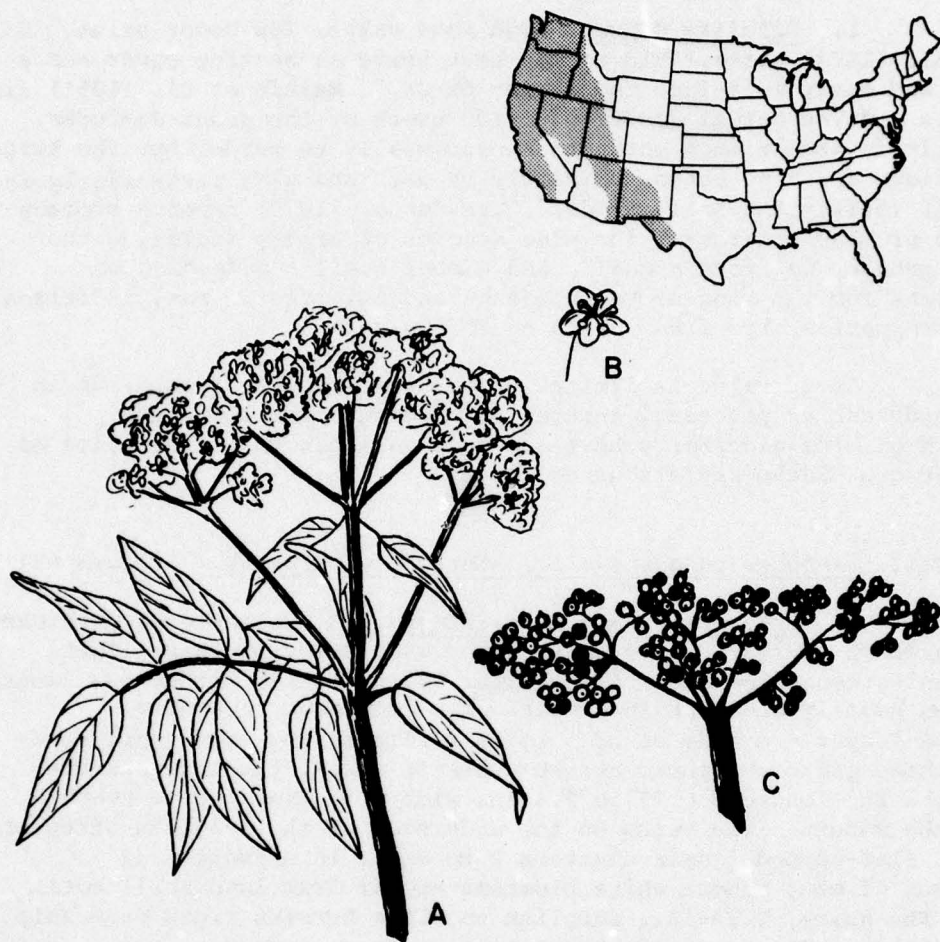


Figure 42. *Sambucus caerulea*, blue elderberry. A, twig with flowers and leaves x 0.6; B, flower x 2; C, fruit x 0.5.

e. Disease and Insect Problems. None.

f. Wildlife Value. High food value; low cover value. Gill and Healy (1974) state, "Elders may best serve as nesting cover and a summer and early fall food source for birds." Martin et al. (1951) list 79 users and Van Dersal (1938) over 100 users of the genus *Sambucus*. The fruit is the primary attraction, especially to birds, but the twigs and foliage are also eaten, primarily by deer and elk, particularly in the fall (Bailey and Bailey 1949). Van Dersal (1938) reports stomach records of blue elderberry for nine species of birds, including the ruffed grouse, California quail, and Gambel quail and feeding observations for the ring-necked pheasant and mule deer. Many additional wildlife species also likely feed on this plant.

Cover value is limited unless thickets are formed; it is most important as perching, escape, or nesting cover for birds. Thickets of blue elderberry have the same valuable characteristics as the American elderberry discussed below.

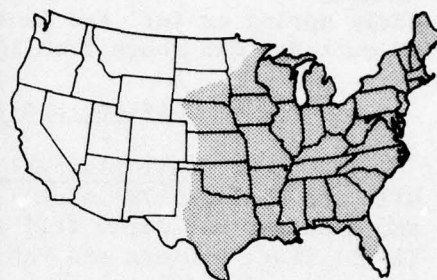
213. *Sambucus canadensis* L., American elderberry. (Figure 43)

a. Description and Life History. A stoloniferous, thicket-forming shrub to 12 ft. The bark of the main stems is thin, light brown and greenish beneath; the smaller green, nearly herbaceous lateral branches usually die back in winter. The deciduous, opposite, compound leaves are made up of 5 to 11 leaflets, the lower pair sometimes three parted. Lanceolate to ovate in shape, the leaflets are 2.75 to 6 in. long and 0.75 to 2.4 in. wide with sharp, fine teeth along the margin. The veins on the underside of the leaflets often are downy. Flat-topped flower clusters 2 to 8 in. in diameter and comprised of many minute white blossoms appear from late April until July. The juicy, 0.25-in., purplish to black berries ripen from July to September. American elderberry is a vigorous grower.

b. Habitat. Two-thirds shade to full sun; fencerows, thickets, old fields, pastures, swamp and alluvial forests.

c. Soil Requirements. Wet to moist sites; pH 5.5 to 6.0; sandy and bottomland soils, gray forest soils and muck.

d. Establishment and Maintenance. Both seeds and plants are available commercially. Seeds should be collected as soon as ripe before consumed by birds. They are prepared for storage or immediate planting by crushing the fruit and drying it with no further separation of pulp and seeds, or by macerating with water to remove the pulp. Untreated seeds, whether sown in late fall or spring, usually will not germinate until the second season. Acid treatment is recommended for both fall and spring planting. Scarify seeds with concentrated sulfuric acid for 10 to 20 min; wash, then prechill at 36°



A



B

Figure 43. *Sambucus canadensis*, American elderberry. A, flowers; B, fruit.

to 40°F for 2 months. Another technique to improve germination is to use a warm/cold stratification scheme. Rather than treating with acid, seeds are placed in moist sand and kept for 60 days at 68° to 86°F alternating daily, followed by 120 days at 41°F (Gill and Healy 1974). Treated and untreated seeds are planted 0.25 in. deep at a rate of 35 seeds per foot. If sown in fall, plantings should be well mulched (Schopmeyer 1974).

Hardwood cuttings are another means of propagation. Cuttings from vigorous 1-year-old canes or stems should be taken in early spring or fall and include three sets of opposite buds. Length of cuttings can range from 10 to 18 in. (Gill and Healy 1974).

e. Disease and Insect Problems. None.

f. Wildlife Value. High food value; medium cover value. Gill and Healy (1974) state, "Elders may best serve as nesting cover and a summer and early fall food source for birds." Martin et al. (1951) list 79 users and Van Dersal (1938) over 100 users of the genus *Sambucus*. The fruit is the primary attraction, especially to songbirds, but the twigs and foliage are also eaten, primarily by deer. Van Dersal (1938) reports stomach records of American elderberry for 43 species of birds, including the ruffed grouse, bobwhite, and ring-necked pheasant; he also records feeding observations of 16 species of birds (including the mourning dove and wild turkey), red squirrel, marsh rabbit, and white-tailed deer. Davison (1967) states that the American elderberry's fruits are a choice food of the eastern bluebird, cardinal, catbird, yellow-breasted chat, rose-breasted grosbeak, blue jay, mockingbird, robin, yellow-bellied sapsucker, white-throated sparrow, starling, brown thrasher, gray-cheeked thrush, Swainson's thrush, wood thrush, rufous-sided towhee, veery, cedar waxwing, red-bellied woodpecker, and red-headed woodpecker and a fair food of the yellow-shafted flicker, great crested flycatcher, Traill's flycatcher, common grackle, eastern kingbird, hermit thrush, and wild turkey. Gill and Healy (1974) say that at least 50 species of birds relish the fruit of American elderberry during summer and early fall.

American elderberry is thicket forming, but the foliage of individual plants is open and stems are bare. It provides fair escape cover for wildlife and provides outstanding nesting cover for small birds. During summer, the partial shade under this plant promotes a dense herbaceous ground cover which offers good resting and feeding areas for broods of pheasant or quail (Gill and Healy 1974).

214. Genus Vaccinium, blueberries. Members of the genus *Vaccinium* are commonly known as deerberries, squawberries, whortleberries, bileberries, farkleberries, huckleberries, cranberries, and blueberries. Hybridization frequently occurs where ranges coincide, consequently identification of the 25 to 35 native species can be difficult. Blueberries grow in many relatively open habitats throughout the United States, except in the Midwest and areas with limestone soils; they are particularly abundant in the eastern coastal plain and in the Allegheny Mountains. Like other members of the heath family, blueberries prefer acid soils.

215. Before selecting one of the several species which would be adaptable to dredged material, the characteristic size and amount of berries should be determined because some species have more potential for wildlife utilization than others. Consumption of the edible blueberries by humans is well documented.

216. *Vaccinium corymbosum* L., highbush blueberry. (Figure 44)

a. Description and Life History. A deciduous, erect shrub to 12 ft with many branches in the upper portions. In winter the green warty-dotted twigs turn reddish. The ovate, elliptic, or lanceolate leaves are 1 to 3.2 in. long, 0.6 to 1.6 in. broad. The margins may have very fine teeth. Pinkish-white or white urn-shaped flowers, about 0.25 to 0.45 in. long and arranged in elongated clusters, bloom from late February to June just before or while the leaves are coming out. The juicy, 0.25- to 0.5-in. blue to bluish-black berries ripen with a paler blue coating from June to August, about 3 to 4 months after flowering.

b. Habitat. Filtered light to full sun; bogs, swamps, moist rocky woods, low wet thickets, pine barrens and pine forests, woodland borders.

c. Soils. Wet to well drained; pH 3.5 to 5.5 (optimum pH 4.3 to 4.8); sands, sandy loams, clay loams, clays, stony and gravelly silts.

d. Establishment and Maintenance. Highbush blueberry seeds and stock are commercially available. To propagate by cuttings, the usual method of developing planting stock, hardwood cuttings, 0.25 in. or less in diameter, are taken in early spring immediately before bud growth starts. Fruit buds should be rubbed off cuttings; the shoots of last year's growth should be cut below a bud in 3- to 5-in. segments and treated with a fungicide before planting in a 1 to 1 rooting mixture of sand and horticultural peat. Rooted cuttings may be left in propagating beds through the winter, or they can be transplanted in early fall into nursery beds to allow adequate root growth before winter (Gill and Healy 1974).

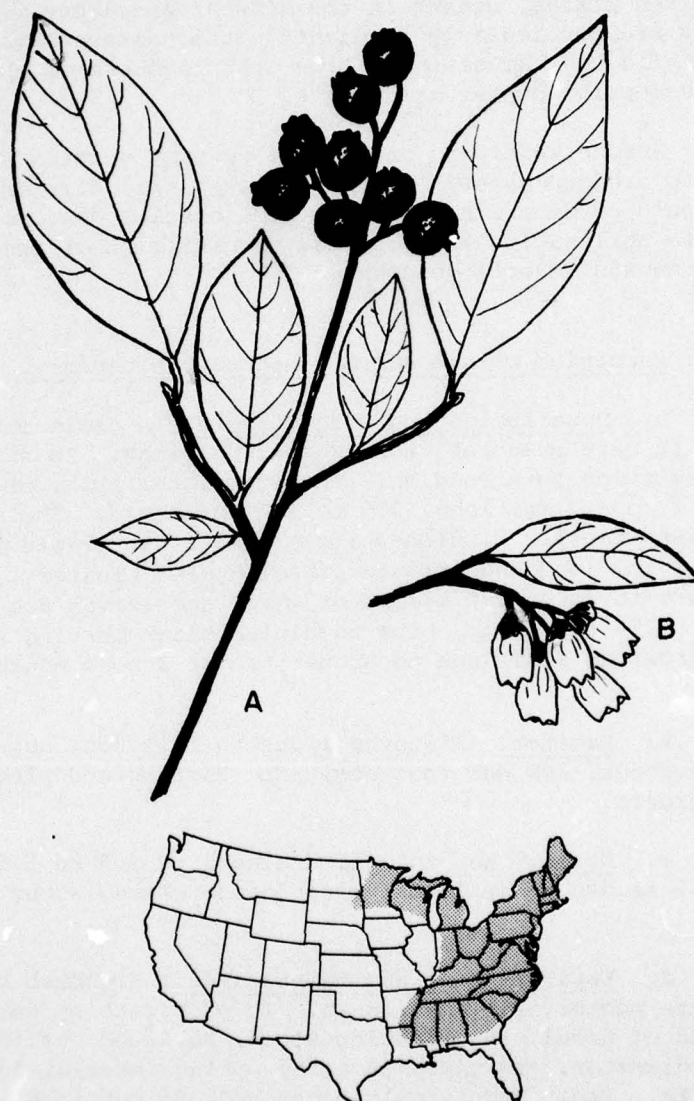


Figure 44. *Vaccinium corymbosum*, highbush blueberry. A, twig with leaves and fruit x 1; B, flowers x 1.

Highbush blueberry can also be grown from seeds. Chilling ripe berries at 50°F for several days prior to cleaning by macerating with water has been found to improve germination rates (Gill and Healy 1974). Plant cleaned seeds in a 1 to 1 mixture of sand and horticultural peat. Within a month seeds will begin to germinate and continue to do so over a long period. Seedlings should be transplanted into nursery beds 6 to 7 weeks after emergence. After one season's growth they can be field planted. For greatest berry production, spacing plants 4 to 8 ft apart and rows 8 ft apart is recommended. For maximum flowering and fruiting, highbush blueberry should be planted in full sun and competing vegetation should be eliminated or reduced to a minimum.

Blueberries have been found to be exacting in site requirements and establishment efforts on less favorable sites have not been particularly successful (Schopmeyer 1974).

e. Disease and Insect Problems. None.

f. Wildlife Value. High food value; low cover value. For the genus *Vaccinium*, Martin et al. (1951) give 53 wildlife users, Van Dersal (1938) reports over 100 wildlife users, and Davison (1967) lists 40 bird users. Wildlife users include the band-tailed pigeon, wild turkey, black bear, opossum, raccoon, as well as skunks, foxes, several species of grouse, and many songbirds for which the fruits are the main attraction. The plants are also browsed by deer and rabbits (Dale 1961). Documented records of wildlife use of specific species of *Vaccinium* are limited. For the highbush blueberry, Van Dersal (1938) records feeding observations of the mourning dove, ruffed grouse, ring-necked pheasant, and cottontail rabbit. However, highbush blueberry is probably used by all of the animals referenced above which occur within its range.

This deciduous shrub provides limited concealment and perching sites for birds feeding on the fruits.

g. Comments. Highbush blueberry is the parent of most cultivated varieties of blueberries (Grimm 1966).

217. *Vaccinium ovatum* Pursh, western huckleberry. (Figure 45)

a. Description and Life History. An evergreen, erect, branched shrub 2 to 8 ft tall. The thick, leathery leaves are dark green and glossy, somewhat paler on the undersides. Foliage on new shoots is a brilliant copper bronze. The leaves are ovate or oblong-ovate in shape, 0.5 to 1.25 in. long and 0.25 to 0.5 in. wide. In April and May bunches of one to five white or pinkish flowers appear on the underside of the branches. Each urn-shaped flower is about 0.25 in. long. The blue-black, shiny berries are ovoid in shape, about 0.25 in. in diameter, and are sweet in flavor when they ripen in late summer. Growth is relatively slow.

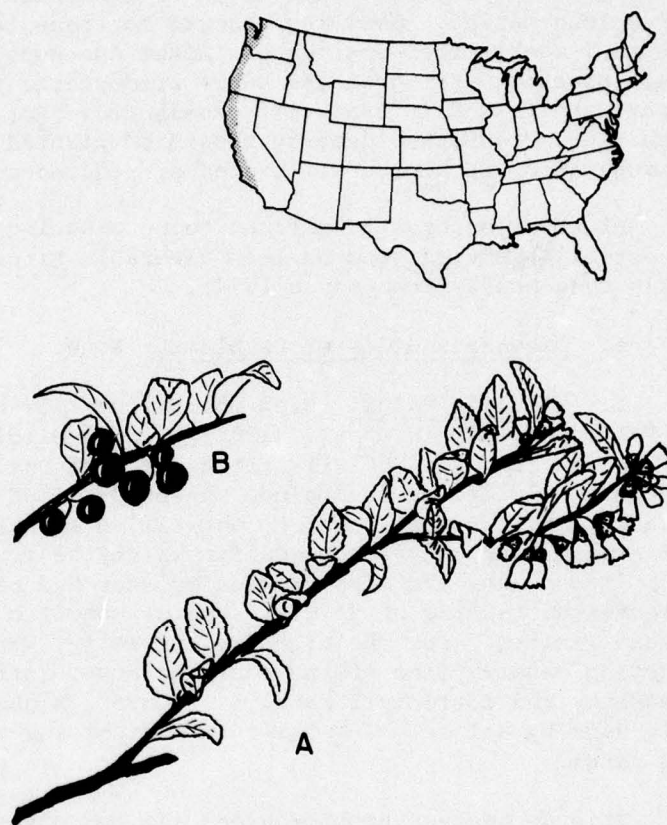


Figure 45. *Vaccinium ovatum*, western huckleberry. A, twig with leaves and flowers x 0.75; B, fruit x 0.75.

b. Habitat. Full shade to full sun; coastal dunes, ocean bluffs, and mixed evergreen, redwood, and Douglas fir forests.

c. Soil Requirements. Moist to well drained to dry; pH 4.0 to 5.5; sands, sandy soils, shallow soils.

d. Establishment and Maintenance. Western huckleberry may be commercially available. Plants can be propagated from cuttings and seeds by the methods described for highbush blueberry in the foregoing section. However, stratification of seeds for 3 months is recommended (Emery 1964). Nursery stock is readily established, and small plants are readily transplanted from the wild. Well-drained, acid soils are required for good establishment and optimum growth (Brown and Hafenrichter 1962, Grant and Grant 1967).

e. Disease and Insect Pests. None.

f. Wildlife Value. High food value; medium to high cover value. The wide wildlife use of the genus *Vaccinium* is presented under the highbush blueberry. Documentation of the specific use of the western huckleberry is limited--Van Dersal (1938) reports stomach records for the ruffed grouse and feeding observations for elk and mule deer. However, the western huckleberry is probably used by many additional wildlife species.

The western huckleberry is an evergreen shrub which frequently forms dense cover. Thus it provides nesting, perching, feeding, and resting sites for wildlife.

g. Comments. The glossy, evergreen foliage is widely harvested for Christmas decorations. Western huckleberry is often planted as an ornamental.

Vines

218. Genus *Lonicera*, honeysuckle. Though 24 native honeysuckles are recognized in the United States, only an introduced species, Japanese honeysuckle (*Lonicera japonica*), has considerable wildlife importance, mainly because of its abundance. Two introduced shrub honeysuckles, Tartarian honeysuckle (*Lonicera tatarica*) and Amur honeysuckle (*Lonicera maackii*), are suggested for a variety of uses by the SCS (USDA-SCS 1969-1976) and would be useful for wildlife habitat on some dredged material areas. The fruits of these two species are used by at least 17 species of songbirds. They are not readily browsed by livestock, deer, or rabbits. "Rem-red" is a heavy-fruiting variety of Tartarian honeysuckle. It was developed by the SCS and is available commercially (USDA-SCS 1969-1976).

219. *Lonicera japonica* Thunberg, Japanese honeysuckle.
(Figure 46)

a. Description and Life History. An aggressive perennial evergreen vine with twining stems. It is not a high climber but tends to form dense masses of low growth which over-top low growing shrubbery. The trailing vines will root at the nodes where covered with duff and in contact with the soil. The leaves are pointed, oblong, 1.25 to 2.75 in. long, and about half as wide. They are dark green on top and lighter green beneath. Small clusters of white or pink fragrant flowers blossom during the early summer months. These are followed by dark, glossy berries which begin to mature in midsummer. In winter the fruit remains on the stems unless eaten by wildlife. "Hall's honeysuckle" is a widely cultivated and commercially available selection.

b. Habitat. Sunny to three-fourths shade; fencerows, road banks, stream banks, woodlands, borders.

c. Soil Requirements. Moist to well drained, rich to moderately poor; pH 4.8 to 7.5; clay, loam, sandy loam, silt.

d. Establishment and Maintenance. The easiest method for gathering plants is to scythe an area where Japanese honeysuckle forms a dense ground cover and dig up the rooted vines in clumps (USDA-SCS 1968-1976). Well-rooted clumps can be planted directly on the site 3 to 6 ft apart. Mulching bare areas around the plants speeds establishment. Leafy branches of hardened growth taken in the summer root easily when propagated under glass.

Cleaned seeds planted and mulched in the fall on dredged material will produce a scattering of seedlings in the spring. Germination is not high; however, establishment of a widely spaced stand would



Figure 46. *Lonicera japonica*, Japanese honeysuckle. A, habit x 0.5; B, flowers x 1; C, fruits x 0.5; D, seeds x 2.5.

be sufficient. Seedlings grow slowly and need the protection of a nurse crop.

After seedlings are well up, they should have one or two broadcast applications of 10-10-10 fertilizer during the growing season. Use 5 lb of 10-10-10 per 1000 sq ft for medium-textured, well-drained soils and 10 lb per 1000 sq ft for coarse-textured, wet soils. If clumps are planted, they should be spot fertilized as needed.

e. Disease and Insect Problems. None.

f. Wildlife Value. Medium food value; high cover value. Both the foliage and the fruit of this twining evergreen vine are eaten. Davison (1967) states that the black fruit is a choice food of the eastern bluebird and cedar waxwing and a fair food of the catbird and hermit thrush; the nectar is an attractive food source of the ruby-throated hummingbird. The fruits also are eaten by the bobwhite, wild turkey, purple finch, eastern goldfinch, pine grosbeak, junco, robin, and white-throated sparrow (Martin et al. 1951). Japanese honeysuckle is relished by deer which forage on both new and old growth, primarily in winter (Halls and Goodrum 1961). Cottontail rabbits feed on the foliage and fruit.

The evergreen foliage and thick tangles of vines provide excellent nesting sites for many species of songbirds and ideal cover for cottontail rabbits, bobwhite, wild turkey, various small birds and mammals.

g. Comments. Where growing conditions are especially suitable, Japanese honeysuckle may grow rapidly, climb on adjacent shrubs and trees, form dense growths which exclude native vegetation, and become very difficult to control or eradicate. This trait makes the species a serious pest to some individuals with botanical, forestry, agricultural, or landscape beautification interests. This same trait makes it a valuable wildlife plant. Before establishing Japanese honeysuckle, habit managers should thoroughly evaluate the site and local conditions; state wildlife agencies, SCS personnel, local biologists, or local plant control authorities may offer guidance.

220. Genus Parthenocissus. The genus *Parthenocissus* consists of a small number of species of woody vines that are native to North America and Asia, are closely related to the grapes, and are adaptable to many different growing conditions. Virginia creeper (*Parthenocissus quinquefolia*), one of the most common vines in the East, is the species of this genus with importance to wildlife and with potential for use on dredged material.

221. *Parthenocissus quinquefolia* (L.) Planchon, Virginia creeper.
(Figure 47)

a. Description and Life History. A high climbing perennial vine with aerial root hold-fasts and tendrils. Without support it will grow flat as a ground cover or climb on posts and shrubbery; however, it does not follow fence wire. The leaves are compound, usually with five leaflets each up to 6 in. long and 3.15 in. wide with coarsely serrated margins. The species is known for its brilliant scarlet foliage in the fall. Small greenish flowers which bloom in the spring produce open clusters of blue-black berries in the fall. The berries persist well into the winter. The plant is a vigorous grower.

b. Habitat. Shady to sunny sites; roadsides, fencerows, clearings, dunes.

c. Soil Requirements. Moist to dry; pH 4.6 to 8.0; calcareous soils, beach sands with shell particles, sand, loam, clay.

d. Establishment and Maintenance. Virginia creeper is established readily from seeds collected, cleaned, and fall planted 0.5 in. deep in rows. A light mulch (burlap, pine straw, weed-free hay or straw, etc.) is almost a necessity to ensure germination and emergence. Cleaned seeds may be stored and stratified 2 months prior to the spring planting date. The stratification period is 60 days at normal refrigerator temperature (38° to 41°F). Seeds should be lightly dried before planting.

Virginia creeper may show promise for seeding directly on dredged material along with a protective cover planting. Bare-rooted 1-year-old nursery stock can be used. Other woody plant material should not be planted close by, since Virginia creeper will envelop and smother any upright growth. If the site is bare, a protective cover planting of grass in 2- to 3-ft rows with the Virginia creeper plants spaced on 4- to 6-ft centers is a good arrangement.

If growth is less than satisfactory after the first year, each plant may be spot fertilized as needed. Fertilizer should be placed in a dibble hole about 6 in. from the stem or scattered in a 1-ft circle around the stem.

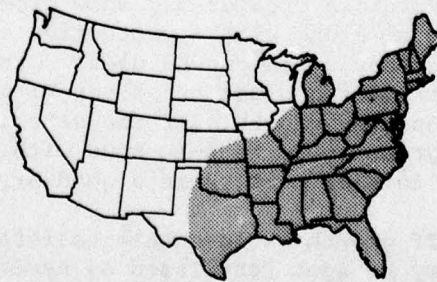
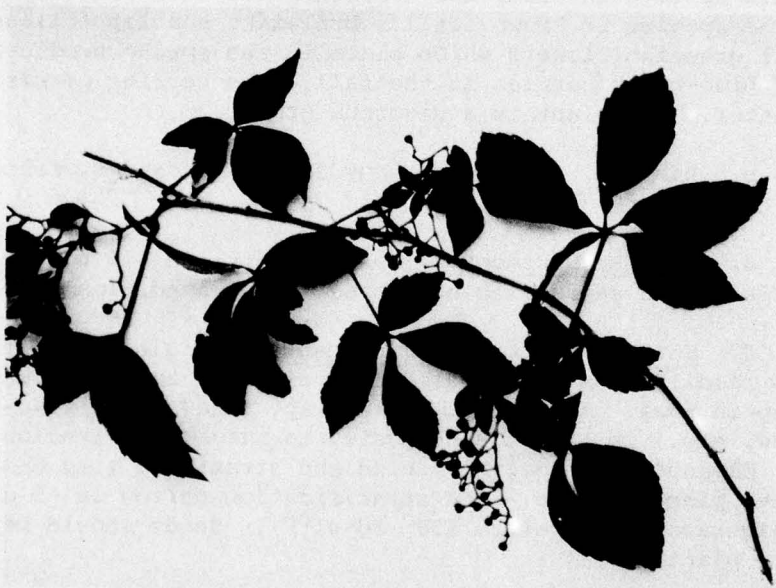


Figure 47. *Parthenocissus quinquefolia*, Virginia creeper. A, habit; B, stems with leaves and fruit. (SCS photos)

e. Disease and Insect Problems. None.

f. Wildlife Value. High food and cover value. The grape-like clusters of fruits are important fall and winter food for wildlife (Martin et al. 1951). Davison (1967) states that the fruit is a choice food of the eastern bluebird, catbird, common crow, yellow-shafted flicker, great crested flycatcher, eastern kingbird, mockingbird, robin, yellow-bellied sapsucker, starling, brown thrasher, Swainson's thrush, red-eyed vireo, bay-breasted warbler, myrtle warbler, downy woodpecker, hairy woodpecker, pileated woodpecker, and red-bellied woodpecker and a fair food of the black-capped chickadee, western kingbird, fox sparrow, tree swallow, wood thrush, hermit thrush, and wild turkey. Van Dersal (1938) reported that the fruit was listed in stomach records of 38 species of birds, including the ruffed grouse, bobwhite, wild turkey, ring-necked pheasant, and greater prairie chicken. Other users include white-tailed deer, eastern chipmunk, red fox, cottontail rabbit, and skunk (Van Dersal 1938, Martin et al. 1951).

This common vine provides excellent summer cover, primarily used by birds for nesting, roosting, escape from predators, and protection from inclement weather. Some leaves may persist into the winter, and, with the tangled vines, provide cover for wildlife.

222. Genus *Smilax*, greenbriers. Approximately a dozen species of woody, thorny greenbriers or catbriers occur in the United States. Most are found in the central and eastern parts of the country in a wide variety of habitats. They grow upon other vegetation and commonly form tangles and thickets. In addition to those species given below, others may be more readily available and equally suitable for wildlife habitat development; local species of *Smilax* should be considered before making a selection. There are evergreen, semievergreen, and deciduous species. All are dioecious; consequently, both male and female plants must be present in plantings to ensure fruit set. Many of the species have very stout prickles. Where such vines are abundant, impenetrable thickets result. Such species are sometimes planted for barriers to foot traffic on dune sites.

223. *Smilax auriculata* Walter, wild bamboo. (Figure 48)

a. Description and Life History. A tough, wiry, evergreen, dioecious vine with tendrils. It climbs on shrubbery or forms green mounds where other taller vegetation is absent. The main stems are coarse, slightly angular in cross section, and usually spineless and arise from gnarled, woody tubers. Since no rhizomes form, the plant does not spread underground; growth is slow. Leaves are oblong to lance shaped and usually lobed on each side at the base; the rounded leaf tips end in an abrupt, sharp point. The leaves are very resistant to salt wind burn. The small greenish male and female spring flowers are not showy. Tight clusters of blue-black berries ripen in early winter and persist until the following spring. The one-seeded berries have a chalky coating and are 0.2 to 0.28 in. in diameter.

b. Habitat. Partial shade to full sun; sand dunes, barrier islands, pine woods along the southern Atlantic and Gulf coasts.

c. Soil Requirements. Moist to dry; pH 5.0 to 7.8 on shell sands; coastal plain sand and sandy loam.

d. Establishment and Maintenance. Wild bamboo is normally propagated from seeds which require 2 years to germinate. Seeds may be collected in December, cleaned, stratified, and held over in this cold damp treatment until the following fall or winter before planting. Seeds can also be cleaned and planted immediately with no expectation of germination until the second spring. Such plantings may accompany a seeding of grass or other herbaceous plant to provide protective cover. Another good practice is to collect, clean, and plant the seeds in an established (living or dead) stand of grass expecting a delay in germination until the following year. Wild bamboo may also be propagated by taking fall or spring cuttings or by dividing the woody tubers. Maintenance will probably not be required.



Figure 48. *Smilax auriculata*, wild bamboo. A, habit; B, stems with leaves and fruits. (SCS photos)

e. Disease and Insect Problems. None.

f. Wildlife Value. High food and cover value. As Gill and Healy (1974) point out, "Of all vines and shrubs in the Northeast, few if any outrank the greenbriers for wildlife food and cover." Goodrum (1961) states, "Greenbriers are considered by many to be the most important group of deer food plants in the South." Documented records for specific species of *Smilax* are limited. For the genus as a whole, Martin et al. (1951) list 33 users and Van Dersal (1938) lists almost 50. Many birds feed on the fruits, and important game animals which feed on *Smilax* include the white-tailed deer, cottontail rabbit, marsh rabbit, swamp rabbit, ruffed grouse, ring-necked pheasant, and wild turkey. The tight clusters of dark-blue to black berries of wild bamboo ripen in late winter, persist through the winter, and thus are available when other foods are often scarce. North Carolina State Parks Division personnel have reported large flocks of seagulls feeding on the fruit during frigid winter weather when other foods were scarce. Low thickets composed partially or totally of wild bamboo provide excellent year-round cover for many wildlife species.

224. *Smilax bona-nox* L., fringed catbrier. (Figure 49)

a. Description and Life History. A spiny, wiry, deciduous vine that can form low tangles and thickets. Four-angled stems with numerous stout spines and many tendrils arise from large woody tubers. The leathery leaves, retained well into winter, vary in shape; they are usually ovate to lanceolate with basal lobes. Spiny hairs may occur along the leaf margins and main veins; the green leaf surface is frequently mottled with pale green. The inconspicuous female flowers appear from April to June and produce clusters of black, white-frosted berries that ripen from September to November. Seeds are usually solitary within the berry.

b. Habitat. Full sun to partial shade; coastal thickets, cut-over woods, bottomland forests, woodland and field borders.

c. Soil Requirements. Moist, well drained to dry; pH 4.5 to 6.5; sand, sandy loams, alluvial soil, clay.

d. Establishment and Maintenance. Fringed catbrier is propagated from seeds by the techniques discussed above for wild bamboo and from cuttings and divisions by the methods given below for common greenbrier.

e. Disease and Insect Problems. None.

f. Wildlife Value. High food and cover value. See the discussion of general wildlife values for the genus *Smilax* given above for wild bamboo. All of the wildlife users mentioned that occur within its range are likely to make use of fringed catbrier. The black berries

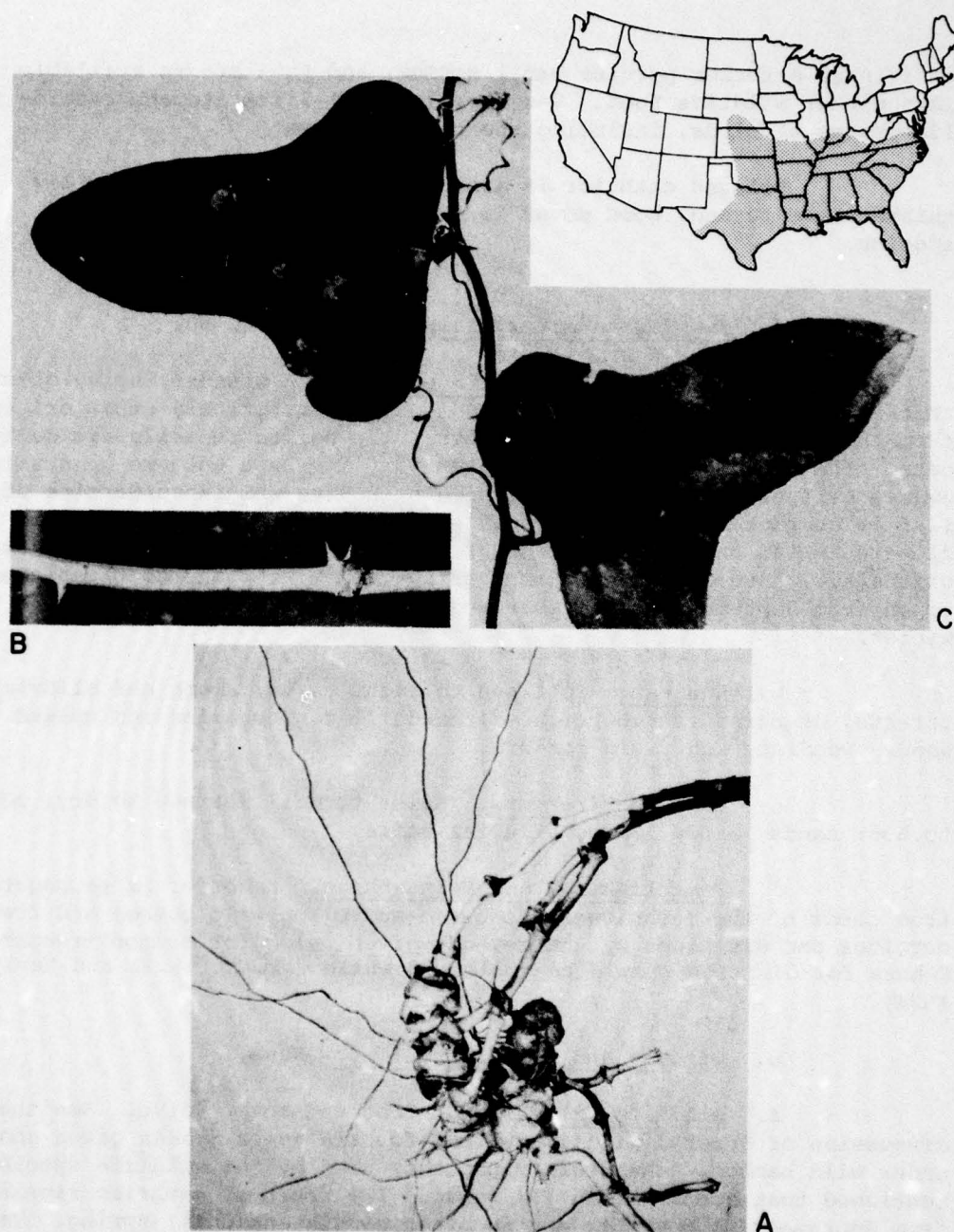


Figure 49. *Smilax bona-nox*, fringed catbrier. A, stem with spines, tendrils and leaves with prickly margins; B, cane with spine; C, underground stems, woody tubers, and root.

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of fringed catbrier persist until spring, and thus are an available late winter wildlife food. Van Dersal (1938) lists stomach records for 13 species of birds, including the ruffed grouse.

Fringed catbrier is armed with stiff spines; where low thickets are formed, good cover is available for various wildlife species.

225. Smilax glauca Walter, sawbrier. (Figure 50)

a. Description and Life History. A slender, spiny-stemmed, thicket-forming vine. The whitish, usually very prickly stems originate from thick, knotty underground tubers. The coiled tendrils are delicate. The thick semievergreen leaves vary in shape but are generally ovate, elliptic, or lanceolate; the distinctive whitish underside of the leaf is characteristic of the species. Nondescript male and female flowers appear on separate plants from late April until June. Clusters of chalky, white-coated blackish berries, each with one to three seeds, ripen from September to November and remain on the vines throughout the winter.

b. Habitat. Full sun to light shade; swamp and alluvial forests, evergreen shrub thickets, sandhill scrubs, pine and upland woods, woodland and field borders.

c. Soil Requirements. Moist to well drained to dry; pH 4.5 to 6.5; sands, sandy loams, alluvial soils.

d. Establishment and Maintenance. Sawbrier is propagated from seeds by the techniques discussed above for wild bamboo and from cuttings and divisions by the methods given below for common greenbrier. Tubers for division should be collected while dormant (Gill and Healy 1974).

e. Disease and Insect Problems. None.

f. Wildlife Value. High food and cover value. See the discussion of general wildlife values for the genus *Smilax* given above under wild bamboo. Sawbrier is probably used by the wildlife species mentioned that occur within its range. The fruit of sawbrier ripens from September to November and is often persistent until spring. Van Dersal (1938) lists stomach records for seven species of birds, including the ruffed grouse. Vines (1960) mentions that cardinal, bobwhite, quail, wild turkey, and ruffed grouse feed on the fruits and that the large tubers are eaten by hogs.

The semievergreen leaves of sawbrier and the stems with needle-like spines make the loose thickets excellent wildlife cover.

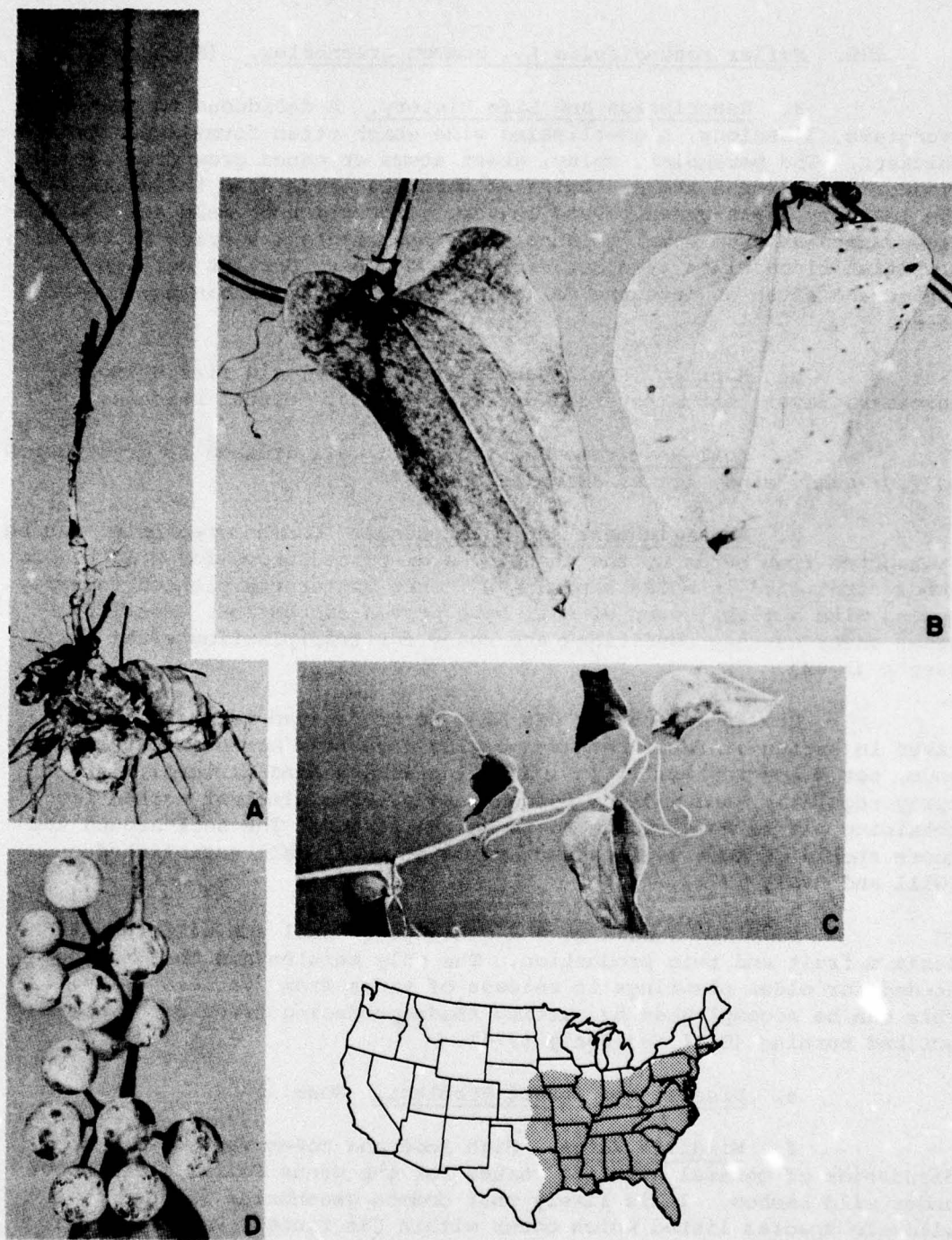


Figure 50. *Smilax glauca*, sawbrier. A, tubers, rhizomes and spiny stem; B, leaves, lower surface (on right) whitish; C, terminal leaves and tendrils; D, white-coated berries.

226. Smilax rotundifolia L., common greenbrier. (Figure 51)

a. Description and Life History. A deciduous to partly evergreen, dioecious, high-climbing vine which often forms impenetrable thickets. The perennial, spiny, green stems or canes grow from long, slender underground stems. Pairs of tendrils arise from the axils of the leathery, dark-green, ovate leaves. Inconspicuous male and female flowers appear from April to June. The bluish-black berries coated with a whitish bloom ripen from September to November, persist well into winter and often on into the following summer, and contain one to three seeds.

b. Habitat. Full sun to light shade; old fields, moist thickets, river bottom forests, deciduous woods, coastal beaches.

c. Soil Requirements. Moist to well drained to dry; pH 5.0 to 7.0; sand, sandy loams, alluvial soils.

d. Establishment and Maintenance. Common greenbrier can be propagated from seeds by the techniques discussed above for wild bamboo. Seeds stratified in moist sand at 40°F over winter and planted in early spring with a light cover of soil have proven successful. Seedlings grown under nursery conditions are ready for transplanting after 1 year's growth.

Common greenbrier can also be propagated from stem cuttings taken in spring or fall. After applying a rooting hormone to the cut ends, set stems vertically in a 3 to 1 peat and sand mixture, mist-spray regularly, and give 30 percent shade. The simplest method for obtaining plants is dividing roots in the spring. The soil around the roots should be kept well packed and moist until well established (Gill and Healy 1974).

Planting seedlings and cuttings in full sun will result in maximum fruit and twig production. The only maintenance that may be needed for older plantings is release of vines from overhead shade. This can be accomplished by cutting shade-producing trees or by prescribed burning (Gill and Healy 1974).

e. Disease and Insect Problems. None.

f. Wildlife Value. High food and cover value. See the discussion of general wildlife values for the genus *Smilax* given above under wild bamboo. It is likely that common greenbrier is used by the wildlife species listed which occur within its range. Van Dersal (1938) reports stomach records for 10 species of birds, including the ruffed grouse; he also reports feeding observations of pileated woodpecker, marsh rabbit, and opossum.

Common greenbrier is a thicket-forming, evergreen, spiny vine which creates excellent year-round cover for wildlife.

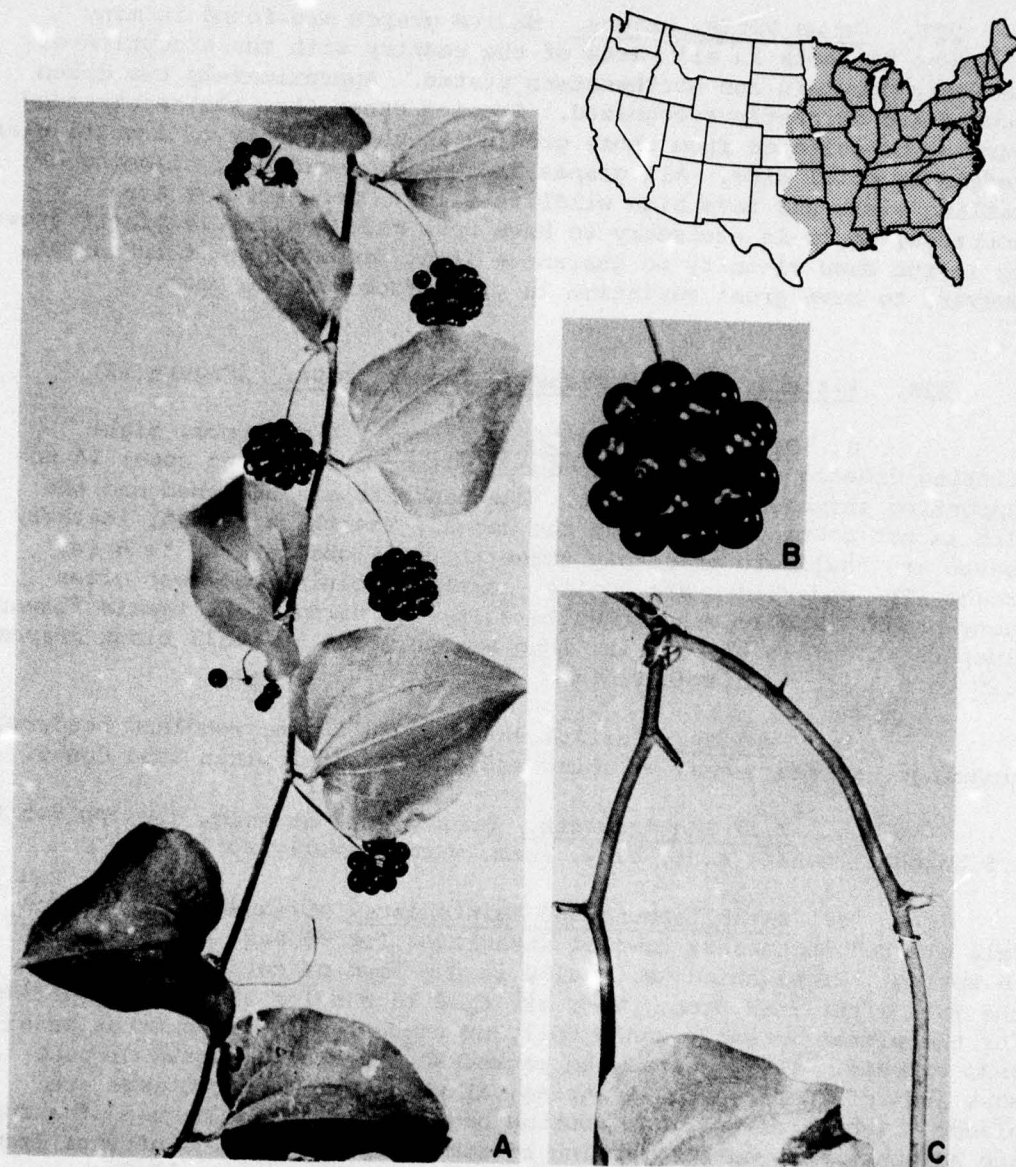


Figure 51. *Smilax rotundifolia*, common greenbrier. A, leafy stem with berries; B, fruit cluster; C, stem with spines.

227. Genus Vitis, grapes. Native grapes are found in many different habitats in all parts of the country with the exception of the Rocky Mountain and northwestern states. Approximately two dozen species are currently recognized. Species other than the recommended four may be selected from those growing in the vicinity of a particular dredged material site. All grapes are woody, deciduous, climbing or trailing vines and have high wildlife value. Some species are dioecious, so it is necessary to have both male and female plants growing in the same vicinity to guarantee fruit production; it is normal, however, to have great variation in yield from year to year.

228. Vitis aestivalis Michaux, summer grape. (Figure 52)

a. Description and Life History. A vigorous, high-climbing dioecious vine that produces a low, open ground cover if no supporting shrubbery is present. The tendrils are branched and the pith is not continuous through the nodes. The thick, rough, leathery leaves are shallowly or deeply three to five lobed and up to 6 in. broad. The undersides are woolly, sometimes bluish but most often rusty brown. The leaves are quite salt-wind hardy. The female flower clusters which are up to 6 in. long are followed by small black grapes 0.25 to 0.5 in. in diameter.

b. Habitat. Partial shade to full sun; woodland borders, clearings, stream banks, Atlantic and Gulf coastal plain sand dunes.

c. Soil Requirements. Moist, well drained, dry; pH 5.5 to 7.5 on shell sands; sand, clay, loam, warm gravelly soils.

d. Establishment and Maintenance. Cleaned seeds may be fall planted in nursery rows or stratified for 90 days and planted in spring. Propagation is usually in the form of cuttings taken in the fall after leaf drop. They are tied in bundles and stored outside for the winter in sand, sandy soil, or sawdust with the butt or basal ends exposed. They also may be packed in boxes of sphagnum or peat moss and refrigerated until spring, at which time the cuttings are placed (right side up) in a rooting bed under glass. The use of a rooting hormone improves the rooting of some grape species. Cuttings from the middle and basal parts of the stems root best (Doran 1937).

Well-rooted seedlings or cuttings are planted during the dormant season on the dredged material. Other woody supportive vegetation may also be included. On very exposed windy sites, it is wise to secure a herbaceous cover a year in advance to protect new vulnerable woody plantings.

Fertilizer (8-8-8) is used sparingly at planting time and care is taken to keep it well under or to one side of the plant. In subsequent years fertilizer is applied as required to ensure healthy growth. Fruits are produced approximately 3 years after establishment.



Figure 52. *Vitis aestivalis*, summer grape. A, habit; B, leaves and fruit. (SCS photos)

e. Disease and Insect Problems. None.

f. Wildlife Value. A wide range of wildlife feed on plants of the genus *Vitis*; Martin et al. (1951) list 75 users, and Van Dersal (1938) lists more than 90. Most wildlife users feed on the ripened grapes in late summer and early fall; even the dried clusters are sought in early winter. Grapes are eaten by ruffed grouse, ring-necked pheasant, band-tailed pigeon, bobwhite, wild turkey, black bear, opossum, raccoon, skunk, fox, and a wide variety of songbirds. White-tailed deer and cottontail rabbits eat the foliage and stems.

Grape stands provide excellent escape and nesting cover for birds; predators may be excluded by twisted or tangled vines. Gray squirrels sometimes use grape vine bark in the construction of leaf nests, and trees with grape vines in them seem to be preferred sites for leaf nests (Gill and Healy 1974). Birds often use the stringy bark of grape vines in nest building (Martin et al. 1951).

Specific documentation of users of summer grape is minimal; however, it is probably used by all of the wildlife species listed for the genus which occur within its range. Van Dersal (1938) records stomach records for eight species of birds, including the ruffed grouse and bobwhite, and feeding observations for the cardinal, cowbird, wild turkey, and white-tailed deer. Davison (1967) states that the fruit is a choice food of cardinal, catbird, ruffed grouse, robin, brown thrasher, wild turkey, and red-bellied woodpecker.

229. *Vitis riparia* Michaux, riverbank grape. (Figure 53)

a. Description and Life History. A high climbing vine with loose, shredding, reddish-brown bark on the older stems. Tendrils or flower clusters are absent from every third node; the pith is not continuous through the nodes. The dark-green leaves are generally circular or heart shaped with coarse, sharp serrations. After the first year the leaves are usually three lobed, all lobes being similar. The margins of the leaves have fine hairs. After flowering in May or June, compact clusters of black to deep purple grapes with a white coating ripen in September and October.

b. Habitat. Shade to filtered sun; river banks, stream banks, bottomland forests, moist thickets, roadsides.

c. Soil Requirements. Moist; pH 4.8 to 7.2; alluvial and sandy bottomland soils.

d. Establishment and Maintenance. Riverbank grape is propagated using the techniques given below for muscadine grape.

e. Disease and Insect Problems. None.

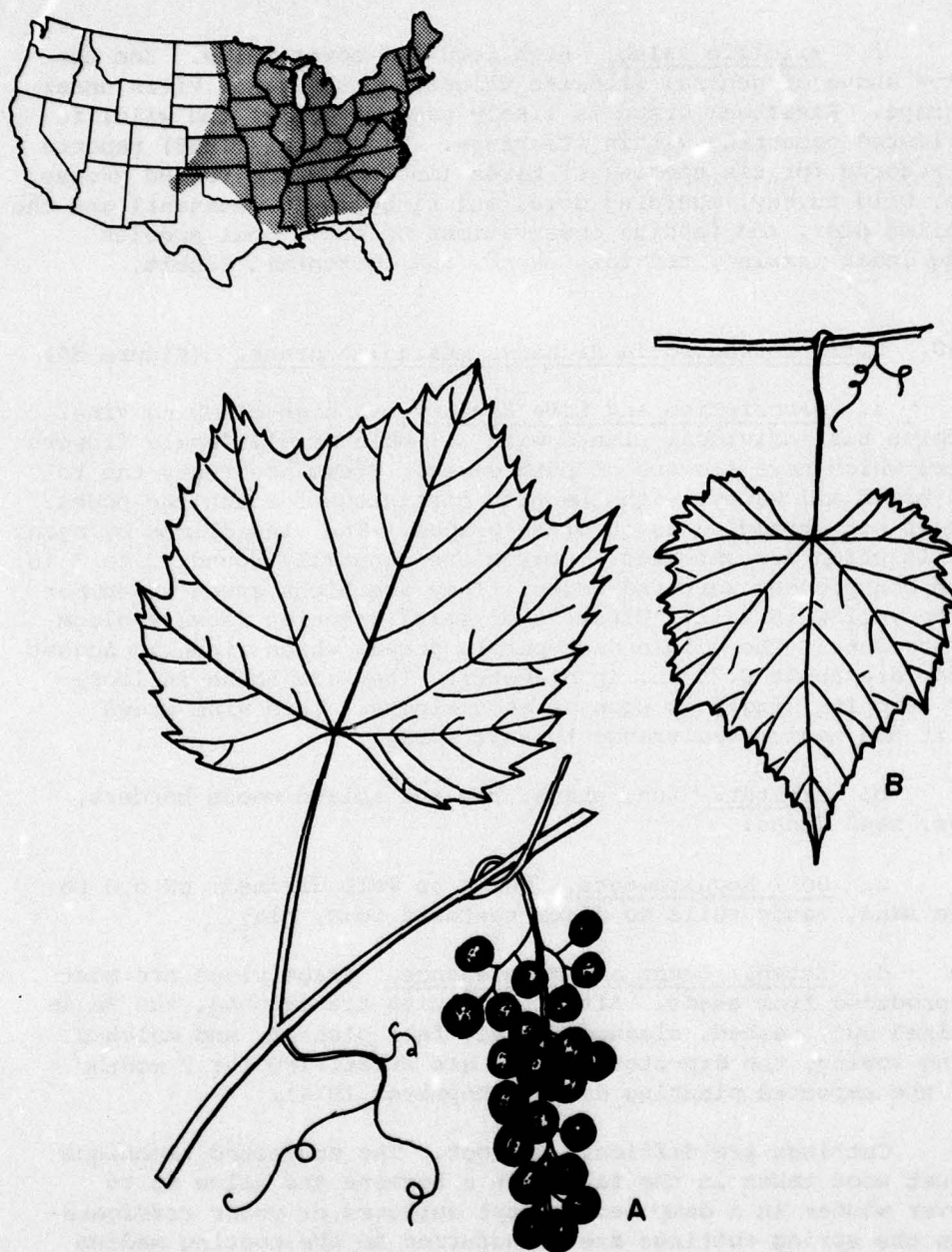


Figure 53. *Vitis riparia*, riverbank grape. A, leaf, tendrils, fruits x 0.5; B, leaf x 0.5.

f. Wildlife Value. High food and cover value. See the discussion above of general wildlife values for the genus *Vitis* under summer grape. Riverbank grape is likely used by all of the wildlife species listed occurring within its range. Van Dersal (1938) reports stomach records for six species of birds (including the ruffed grouse, bobwhite, wild turkey, mourning dove, and ring-necked pheasant) and the white-tailed deer, and feeding observations of additional species including cedar waxwing, red fox, skunk, and cottontail rabbit.

230. *Vitis rotundifolia* Michaux, muscadine grape. (Figure 54)

a. Description and Life History. A high climbing vine, this species has individual plants with all male or all female flowers and others which have flowers of both sexes. Stems are rusty tan to purplish brown and warty, with the pith continuous through the nodes. The bark is not shredding as in other grapes. The vine climbs by means of tendrils which are unforked. Leaves are generally round, 2 to 3 in. wide with conspicuous serrated edges. They are light green in summer turning to yellow in fall. Clusters of small greenish flowers bloom from May to June. The edible dark-purple grapes which ripen in August to October are about 0.75 in. in diameter. They are borne in loose clusters dropping singly as soon as each ripens. This vine grows slowly; it has medium resistance to salt spray.

b. Habitat. Sun, shade; low and upland woods borders, fencerows, sand dunes.

c. Soil Requirements. Moist to well drained; pH 5.0 to 7.6; dune sand, sandy soils to finer textured loam, clay.

d. Establishment and Maintenance. Grape vines are most readily produced from seeds. After the fruits are crushed, the seeds are strained out, washed, cleaned, dried, fall planted, and mulched. For spring sowing, the dry-stored seeds are stratified for 2 months prior to the expected planting date (Schopmeyer 1974).

Cuttings are difficult to root. The suggested technique is to treat wood taken in the fall with a hormone and allow it to overwinter in a damp medium kept outdoors or under refrigeration. In the spring cuttings are transferred to the rooting medium where they are allowed to grow for a full season before transplanting.

Vines left to trail on the ground without supporting shrubbery will produce few grapes. It is better to plant these grapes as an improvement where some shrubbery and trees already exist to provide support for the vines. There is a second alternative. Most recommended shrubbery will grow faster than the grape. When planting several woody species, it is often best to use the grape in limited quantities and small groups. The vines should be planted 6 to 8 ft apart and 4 or 5 ft from a newly planted shrub or tree.

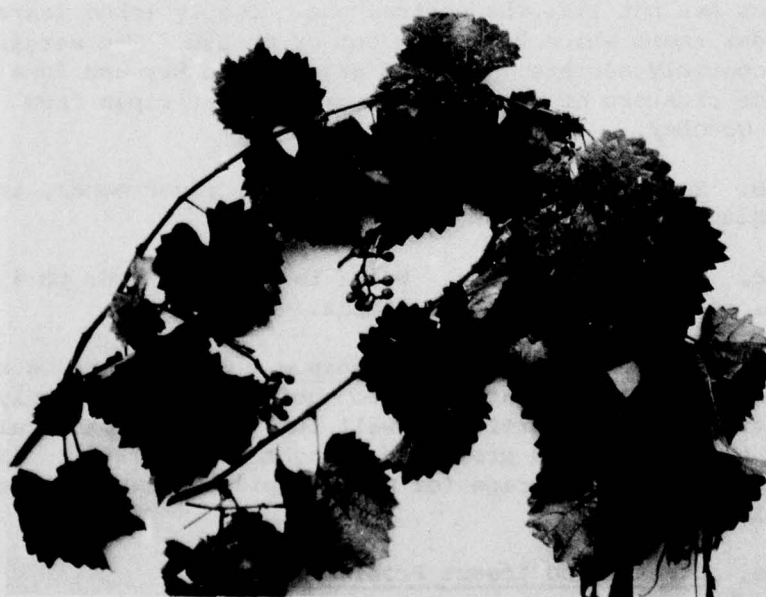
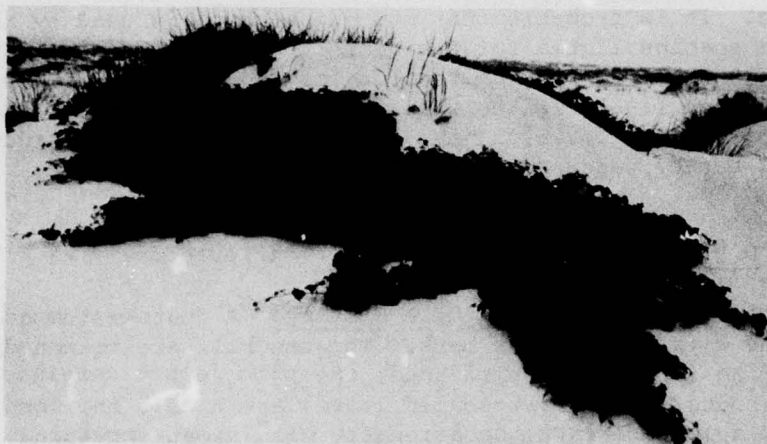


Figure 54. *Vitis rotundifolia*, muscadine grape. A, habit; B, leaves and fruit. (SCS photos)

Growth is naturally slow, so annual fertilization for the first few years is advantageous.

e. Disease and Insect Problems. The vigor, long life, and freedom from disease of this species is unsurpassed among grapes. It is never attacked by rot or mildew (Vines 1960).

f. Wildlife Value. High food and cover value. See the discussion above of general wildlife values for the genus *Vitis* under summer grape. It is probable that muscadine grape is used by all of the wildlife species listed for the genus that occur within its range. Van Dersal (1938) lists stomach records for the cardinal, bobwhite, and opossum. Davison (1967) states that the fruit is a choice food of the cardinal, common grackle, blue jay, summer tanager, rufous-sided towhee, wild turkey, and red-bellied woodpecker.

231. *Vitis vulpina* L., frost grape. (Figure 55)

a. Description and Life History. A coarse-stemmed, high-climbing vine with loose brown bark. The tendrils are branched and usually lacking from every third node; the pith is not continuous through the nodes. The heart-shaped leaves are 3 to 5 in. long, glossy green above, duller beneath, occasionally with short-spreading, sometimes cobweblike hairs. They are usually unlobed; if lobed, however, the side lobes are not like the central one. Deeply lobed leaves are common on older stems which have been cut or burned. The margins are sharply and coarsely serrate. Flowers produced in May and June form slender, loose clusters of glossy black grapes that ripen from September to October.

b. Habitat. Shade to filtered sun; river banks, stream banks, floodplains, moist upland woods.

c. Soil Requirements. Moist to well drained; pH 4.8 to 7.2; alluvial sandy bottomland and uplands.

d. Establishment and Maintenance. Frost grape is readily grown from seeds which germinate and grow quickly and vigorously and also from cuttings. It endures cold well but it is not particularly resistant to summer heat and prolonged drought (Vines 1960). (See discussion under muscadine grape for more complete establishment and maintenance information.)

e. Disease and Insect Problems. None.

f. Wildlife Value. High food and cover value. See the discussion of general wildlife values for the genus *Vitis* under summer grape. Frost grape is likely used by the wildlife species listed which occur within its range. Van Dersal (1938) lists stomach records for

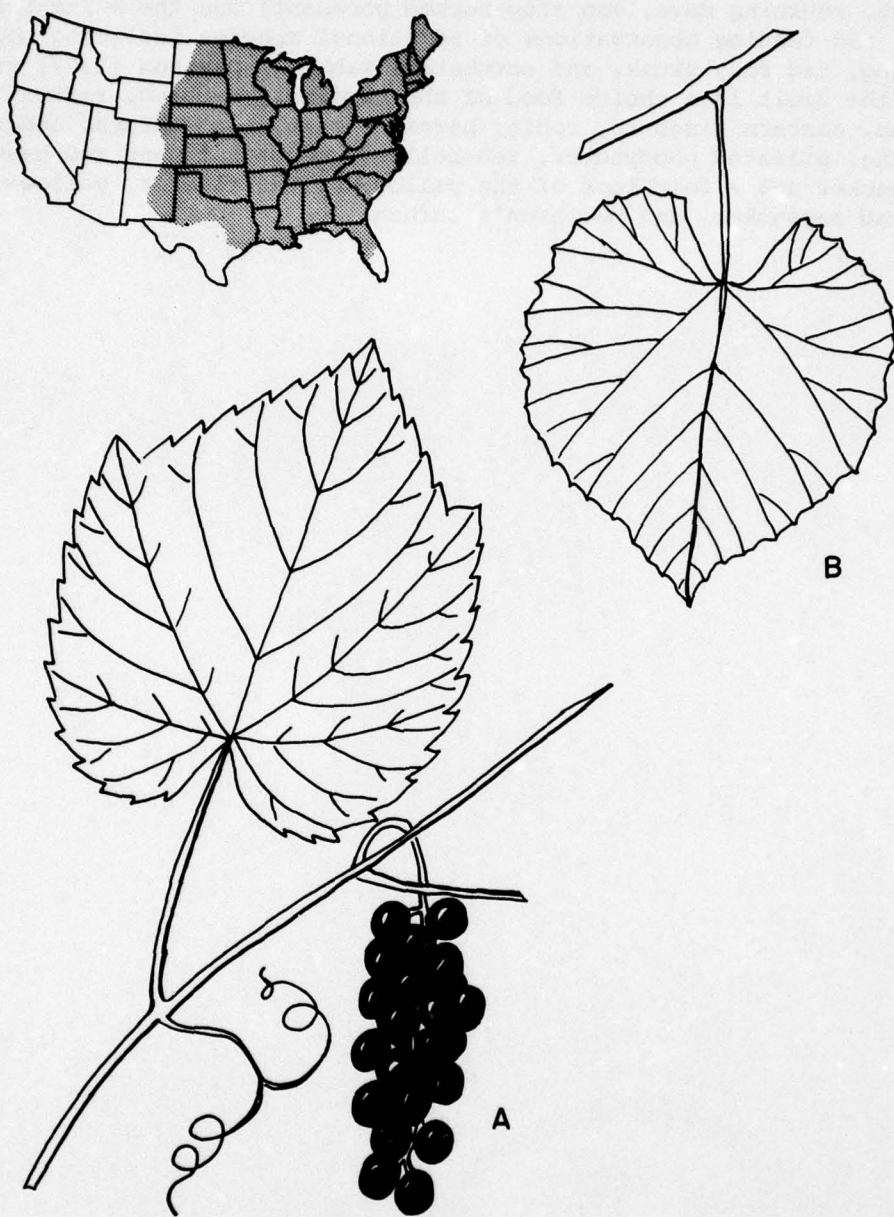


Figure 55. *Vitis vulpina*, frost grape. A, leaf, tendrils, fruits x 0.5; B, leaf x 0.5.

six species of birds (including the ruffed grouse, bobwhite, wild turkey, mourning dove, and ring-necked pheasant) and the white-tailed deer, and feeding observations of additional species including cedar waxwing, red fox, skunk, and cottontail rabbit. Davison (1967) states that the fruit is a choice food of the cardinal, catbird, ruffed grouse, eastern kingbird, robin, hermit thrush, wood thrush, cedar waxwing, pileated woodpecker, red-bellied woodpecker, and red-headed woodpecker and a fair food of the yellow-shafted flicker, yellow-bellied sapsucker, and Swainson's thrush.

Herbs

232. Genus *Amaranthus*, pigweeds. Notorious weeds of cropland, common inhabitants of barnyards and feedlots, red-leaved cultivars of gardens, decumbent herbs on dunes, and gigantic shrub-like plants of coastal marshes are but a few of the diverse forms of the genus *Amaranthus*, commonly called pigweeds. About half of the species of pigweeds are found in the United States. The numerous seeds produced on a single plant, the tardiness of fruit dehiscence, and the occurrence of pigweeds in habitats likely to have other weedy or seed crop plants are important factors in making this genus despised by agricultural interests but a significant winter food source for wildlife.

233. *Amaranthus retroflexus* L., redroot pigweed. (Figure 56)

a. Description and Life History. A coarse, summer annual with a reddish-pink taproot and red stems streaked with white or green. Leaves are alternate with long blade stalks; the blades are elliptic, ovate, or rhombic-ovate, up to 3 in. long, and 1.5 in. wide; the veins on the undersurface are hairy. Male and female flowers occur in densely crowded spikes located in leaf axils which terminate the main stem or lateral branches. Each flower is subtended by three rigid, sharp-pointed bracts. Fruits are compressed and open around the middle. Seeds are slightly asymmetrical, round-obovate, lustrous, dark reddish-brown to black, and 0.04 to 0.05 in. broad. Plants are often difficult to eradicate.

b. Habitat. Full sun or partial shade of crops; cultivated fields, barnyards, pastures, fencerows, feedlots, waste areas.

c. Soil Requirements. Moist but occasionally dry; pH 5.5 to 8.0; fertile loam, loamy clays, loamy sands.

d. Establishment and Maintenance. Commercial seed sources are probably not available for this pest weed of cultivated fields. Seeds can be obtained by hand-gathering or by selecting waste seeds from a commercial seed-cleaning business. Procedures for preparing a suitable seedbed are similar to those for row crops. The soil should be plowed or disked before planting. To retain soil moisture and to increase soil fertility, the site should remain fallow for several months. Fall plowing is recommended. When the soil warms in the spring, redroot pigweed should be planted in rows 30 to 42 in. apart. Broadcasting the seeds lightly over the area may be a more economical method of planting for small sites. The soil should then be firmed. Germination is variable; seeds from the same plant may germinate a few days after harvest while others may require several months of after-ripening. The seedlings branch early and a stand will naturally thin itself. Flowering and fruiting will begin in early summer and continue until frost.



Figure 56. *Amaranthus retroflexus*, redroot pigweed. A, habit x 0.5; B, pistillate spikelet x 5; C, utricle x 5; D, seeds x 3.

e. Disease and Insect Problems. Related species of *Amaranthus* are known to be vectors of viral diseases. Significant crop losses from diseases and insects at habitat development sites are not expected.

f. Wildlife Value. High food value; low cover value. Pigweeds are common weeds which produce a tremendous number of seeds which persist in densely clustered spikes and are available throughout the winter and early spring when other foods are scarce. Pigweeds are an important food for wildlife, especially songbirds and upland game birds. The seeds are eaten by the mourning dove, ground dove, ring-necked pheasant, bobwhite, California quail, scaled quail, over 40 songbirds, and by some mice and rats. Mule deer, antelope, and cottontail rabbits feed on the plants (Martin et al. 1951).

Unless growing in dense stands, redroot pigweed provides only minor concealment for ground-feeding birds and small mammals.

g. Comments. *Amaranthus* has been implicated in cattle poisonings from ingested fodder contaminated with leaves from members of this genus. The suspected cause of poisoning was from nitrates which had accumulated in the plant tissues.

This species thrives in barnyards, feedlots, and other areas with excessive nutrients.

234. Genus *Ambrosia*, ragweeds. Of approximately six species of ragweeds in the United States, only the common ragweed and western ragweed, discussed below, are of major importance to wildlife. Seeds of the blood ragweed (*Ambrosia aptera*) are of local importance as a wild-life food in the Southwest, and giant ragweed (*Ambrosia trifida*) seeds are of minor importance in the East. Ragweeds are pioneer invaders of broken soil and often occur in cultivated and fallow fields, along roadways, and on dredged material areas. The pollen from these plants is a serious irritant to persons suffering from hay fever and other allergies.

235. *Ambrosia artemisiifolia* L., common ragweed. (Figure 57)

a. Description and Life History. Common ragweed is a shallowly rooted annual herb with lobed leaves and a distinctive odor. Robust specimens may grow to 7 ft. The stems are glabrous or hairy, simple on small or densely crowded plants but branched on large plants. The leaves have six or more lobes and are highly variable in degree of lobing, size, and vestiture. Male and female flowers are located near the top of the plant. The male flowers are in small inverted heads on a branched inflorescence, usually terminal on a branch. The female flowers are fewer and occur in the axils of upper leaves or at the forks of branches. The seeds are 0.16 to 0.2 in. long including the projecting beak. Flowering and fruiting occurs from late July until frost (USDA-ARS 1970).

b. Habitat. Full sun to partial shade; abandoned fields, pastures, roadsides, vacant lots, cultivated fields, barnyards, waste areas, sea beaches.

c. Soil Requirements. Moist to dry; pH 5.0 to 7.6; sands, sandy loams, organic soils, fertile sandy clays.

d. Establishment and Maintenance. Common ragweed does not reproduce vegetatively, and on dredged material sites seedlings may not survive transplant activities. Therefore seeding is required. Seeds can be gathered in the fall, about the time of the first killing frost. Mechanical harvesting should be feasible. After seeds are cleaned they should be stored over winter in a dry place and planted in late spring when the soil has warmed. Treatment of seeds before sowing will not be necessary. The seeds are easily broadcast in a cleared site and should be covered slightly with a roller. Fertilizer is not required, though it may be helpful. Plants will tend to mature while small if stressed by crowding. Natural reseeding should occur after the initial planting.

e. Disease and Insect Problems. None.

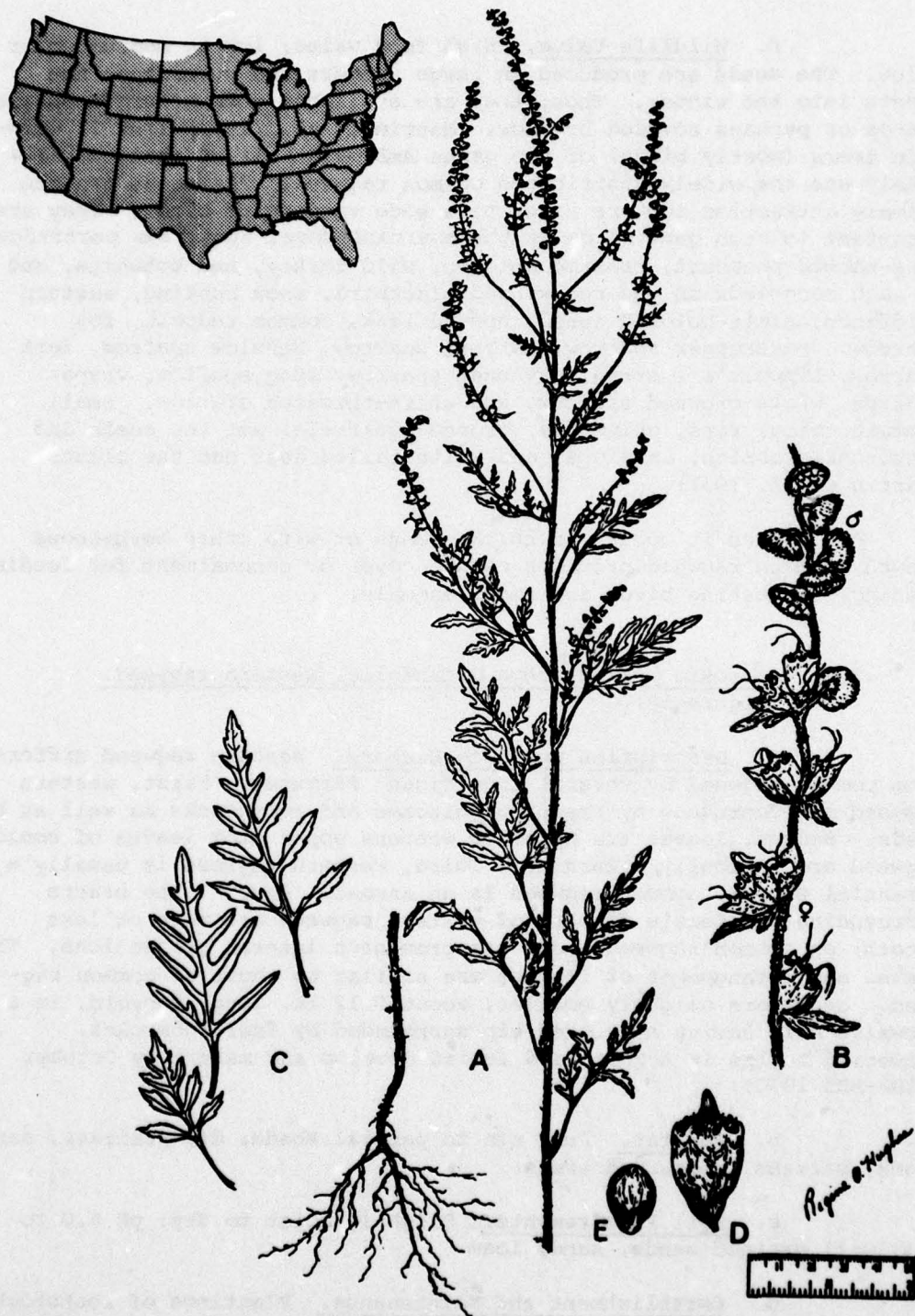


Figure 57. *Ambrosia artemisiifolia*, common ragweed. A, habit x 0.5; B, raceme with male heads (above) and female involucres (below) x 2.5; C, leaf variations x 0.75; D, achene x 5; E, seed x 5.

f. Wildlife Value. High food value; low to medium cover value. The seeds are produced in large numbers and persist on the plants into the winter. Thus, they are available when other foods are scarce or perhaps covered by snow. Martin et al. (1951) list 71 wildlife users (mostly birds) of the genus *Ambrosia*--all of these animals likely use the widely distributed common ragweed. The seeds are the primary attraction and are eaten by a wide variety of birds. They are important to such game birds as the mourning dove, Hungarian partridge, ring-necked pheasant, prairie chicken, wild turkey, and bobwhite, and to such songbirds as the red-winged blackbird, snow bunting, eastern goldfinch, slate-colored junco, horned lark, common redpoll, fox sparrow, grasshopper sparrow, Harris' sparrow, Henslow sparrow, lark sparrow, Lincoln's sparrow, savannah sparrow, song sparrow, vesper sparrow, white-crowned sparrow, and white-throated sparrow. Small mammals (mice, rats, chipmunks, ground squirrels) eat the seeds and cottontail rabbits, antelope, and white-tailed deer eat the plants (Martin et al. 1951).

When it occurs in thick stands or with other herbaceous growth, common ragweed provides escape cover or concealment for feeding, resting, or nesting birds and small mammals.

236. *Ambrosia psilostachya* DeCandolle, western ragweed.
(Figure 58)

a. Description and Life History. Western ragweed differs from common ragweed by several significant features. First, western ragweed can reproduce by creeping rhizomes and rootstocks as well as by seeds. Second, leaves are opposite whereas upper stem leaves of common ragweed are typically alternate. Third, western ragweed is usually a perennial whereas common ragweed is an annual. Fourth, the bracts surrounding the female flowers of western ragweed are more or less smooth; on common ragweed there are prominent lateral projections. The leaves and arrangement of flowers are similar to those of common ragweed. Seeds are slightly smaller, about 0.12 in. long, obovoid, in a brownish hull having a pointed tip surrounded by four tubercles. Flowering begins in August, and fruits develop and mature by October (USDA-ARS 1970).

b. Habitat. Full sun to partial shade; dry prairies, sandy woods, barrens, disturbed areas.

c. Soil Requirements. Slightly moist to dry; pH 6.0 to 8.1; well drained sands, sandy loam.

d. Establishment and Maintenance. Plantings of rootstocks or seeds are possible with this species. Early to late spring plantings are favored over summer or fall plantings. If planting rootstocks, place them 2 ft apart in 3-ft rows with a small amount of lawn-grade fertilizer. If broadcasting the seeds, pack them lightly to prevent.

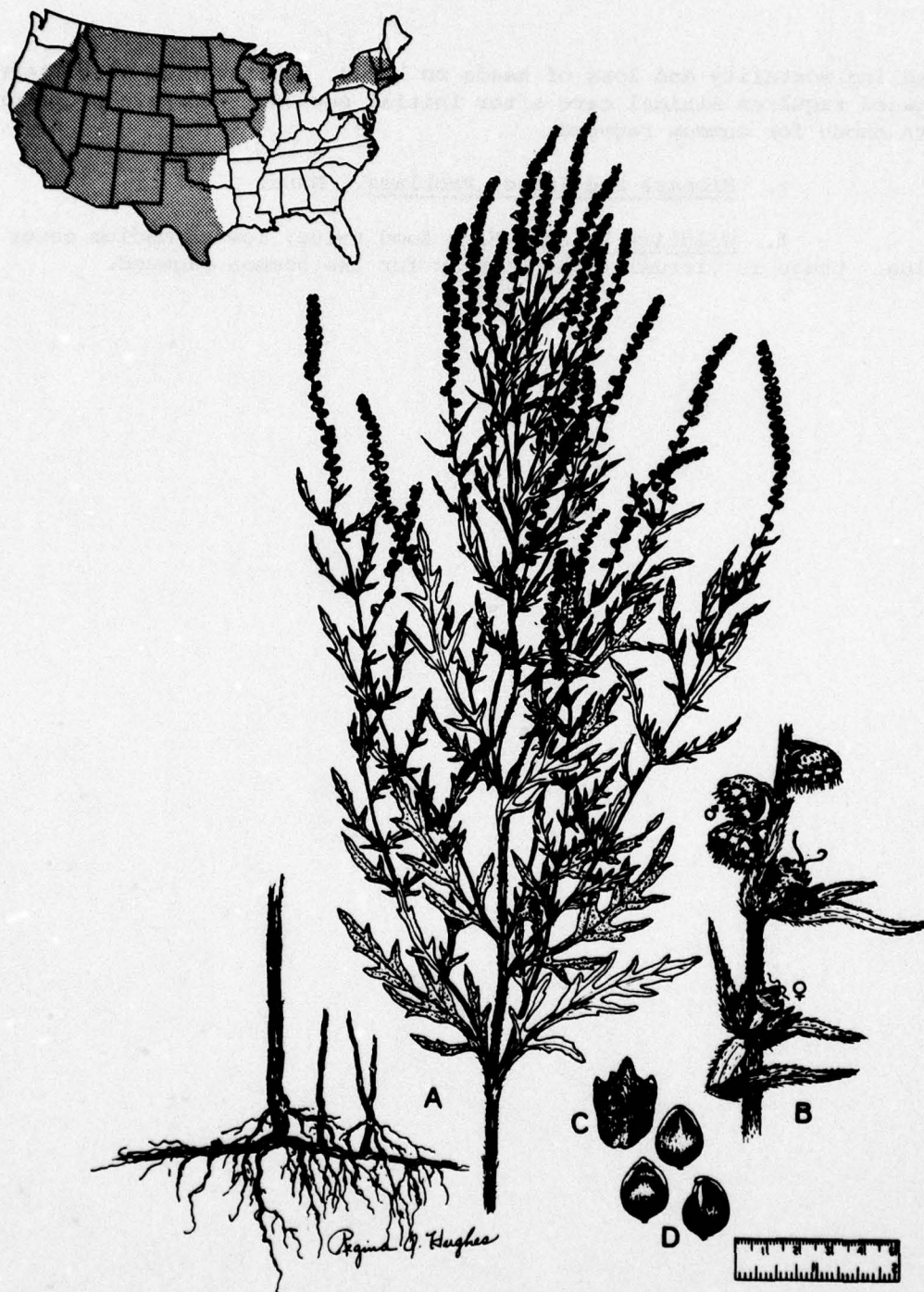


Figure 58. *Ambrosia psilostachya*, western ragweed. A, habit x 0.5; B, raceme of male heads and female involucres x 2.5; C, achene x 3; D, seeds x 3.

seedling mortality and loss of seeds to birds. Cultivation of western ragweed requires minimal care after initial seeding. Compare procedures with those for common ragweed.

e. Disease and Insect Problems. None.

f. Wildlife Value. High food value; low to medium cover value. Usage is virtually the same as for the common ragweed.

237. Genus *Chenopodium*, goosefoot. Approximately 20 species of *Chenopodium* occur in the United States. Some are native and some introduced, and they occur in all parts of the country. They are mostly annual weeds, but the high numbers of seeds produced and the persistence of some seeds make these plants valuable for wildlife. Only one species is discussed below, but others, such as mapleleaf goosefoot (*Chenopodium hybridum*) and wormseed goosefoot (*Chenopodium ambrosioides*), are also used by wildlife (Martin et al. 1951).

238. *Chenopodium album* L., common lambsquarters. (Figure 59)

a. Description and Life History. A common annual field and barnyard weed naturalized from Europe. Stems are erect, bushy, up to 4 ft high but commonly 1 to 1.5 ft high in shaded sites. The young leaves are mealy white, giving a dull bluish-green appearance to the plant; late in the growing season the leaves become reddish-mottled. Leaves are rhombic-ovate to lanceolate. Flowers are numerous, also mealy white, very small, and grouped in a leafy inflorescence which terminates the stem. Flowering time is from June until frost. The fruits contain a single glossy black seed that is 0.04 to 0.06 in. broad.

b. Habitat. Full sun to partial shade or mostly shade; a plant of rich soils; barnyards, feedlots, waste ground, and less frequently cultivated fields and gardens.

c. Soil Requirements. Well drained to moist; pH 4.5 to 7.5; fine sandy soils, loams, loamy silts and clays.

d. Establishment and Maintenance. Commercial availability of this occasionally obnoxious weed is doubtful; therefore, seeds must be obtained by suitable harvesting methods, probably by hand. Plants should be mowed and allowed to sun-dry in the field. Because of the fleshiness of the stems, the seed heads will likely be dry enough for crude threshing before the plants are thoroughly dry. If the seeds are not easily shattered from the drying plants, considerable manual or machine labor to remove the seeds will be required. If done by hand, the plants should be beaten or pulverized over a canvas and the resulting seed-fruit-dried leaf debris then winnowed. Data are not available on recommended planting rates. Assuming a reasonably high percent germination, an estimate of 10 to 20 lb per acre would provide adequate seed to establish a common lambsquarters cover.

e. Disease and Insect Problems. Common lambsquarters is an alternate host for a number of fungal and viral diseases on agricultural crops (Holm et al. 1977).

f. Wildlife Value. High food value; low cover value. The seeds, relished by many birds, persist on the plants into the winter.

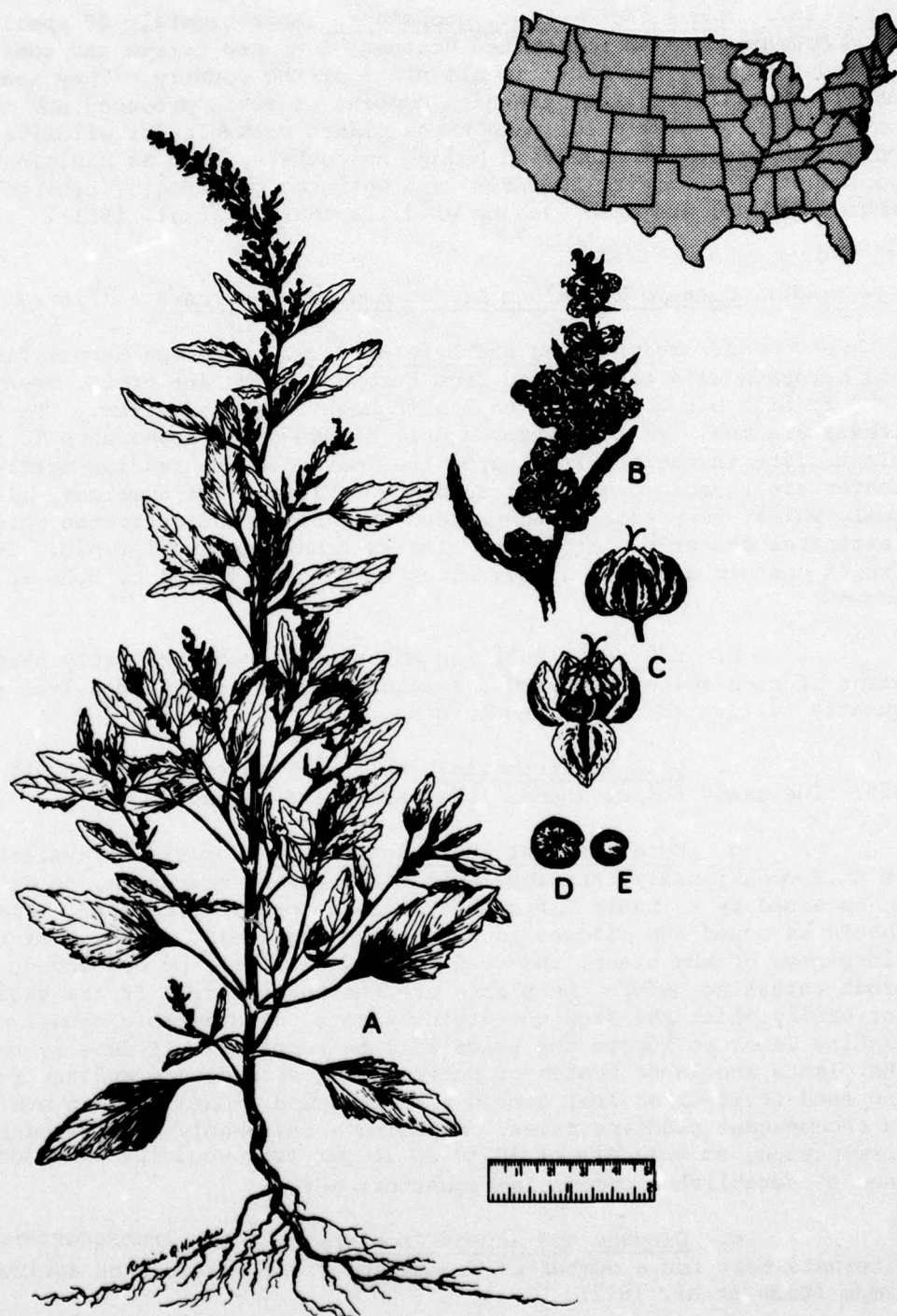


Figure 59. *Chenopodium album*, common lambsquarters. A, habit, small plant; B, floral spike x 2.5; C, flowers x 7.5; D, fruit x 4; E, seed x 4.

This trait, plus the large numbers of seeds produced, makes this plant especially valuable to wildlife. Davison (1967) says that the seeds of *Chenopodium* are a choice food of the snow bunting, American goldfinch, slate-colored junco, horned lark, common redpoll, clay-colored sparrow, Lincoln's sparrow, and white-crowned sparrow, and a fair food of the ground dove, mourning dove, McCown's sparrow, savannah sparrow, song sparrow, tree sparrow, vesper sparrow, and wild turkey. Martin et al. (1951) list 40 users of the genus *Chenopodium*. Upland game birds, such as the mourning dove, sharp-tailed grouse, Hungarian partridge, ring-necked pheasant, bobwhite, and valley quail, and songbirds, such as the Oregon junco, chipping sparrow, and swamp sparrow feed on the seeds. White-tailed deer consume the plants and small mammals (chipmunks, gophers, kangaroo rats) eat the seeds (Martin et al. 1951). All of the above-listed users probably use common lambsquarters.

These plants provide only minor cover, primarily concealment for foraging small mammals and birds.

239. Genus Croton, doveweeds. These weedy plants, which occur in fields, pastures, and other open areas, have large oily seeds which are extensively used by upland game birds, especially doves. About 30 species are present in this country and most occur in the South. Two of the most significant species, woolly croton (*Croton capitatus*) and tropic croton (*Croton glandulosus*), are discussed below. Other important species include the Texas doveweed (*Croton texensis*) and one-seed doveweed (*Croton monanthogynus*). Silver-leaf croton (*Croton punctatus*) occurs in coastal sands in the Southeast. Due to its salt tolerance and natural occurrence on dredged material areas, it may be suitable for management purposes; however, the indeterminate flowering and seed set along with the restricted habitat make collection of seeds difficult.

240. *Croton capitatus* Michaux, woolly croton. (Figure 60)

a. Description and Life History. Woolly croton is a robust branching annual up to 7 ft and characteristically covered by very dense whitish or tawny hairs. In well-drained soils this species forms a long taproot, and the shape of the almost woody herb is conic. In poorly drained sites the roots may spread horizontally and the plant forms a flattened crown. The leaves are grayish green, lanceolate, about 3 in. long, and 1.5 in. wide. The flowers are grouped according to sex; the male flowers are in terminal spikes, while the female flowers are clustered at the base of the male spike. Flowering begins in June and continues as new branches with inflorescences are formed. The fruit, a capsule, is erect and often obscured by the densely hairy calyx. Seeds are three per capsule; glossy brown, gray, or mottled; ovoid; and 0.2 in. long. The fruits ripen in late fall. The genus *Croton* ejects its seeds by an "explosive" mechanism due to tension on the capsule walls. The seeds may be flung several feet from the parent plant.

b. Habitat. Full sun; pastures, sandy cultivated fields, abandoned fields, waste places.

c. Soil Requirements. Slightly moist to dry; pH 4.8 to 7.2; well-drained sandy loams, sands.

d. Establishment and Maintenance. Seeds are probably not available from commercial sources but possibly may be obtained as a waste product from seed-cleaning operations. A crop most likely to have woolly croton contamination is soybeans since the two species are similar in habit and have seeds not completely unlike. If such sources are not available, the plants must be gathered by hand and allowed to dry. When dried, the capsules will open and the seeds pop out. Dry, cold storage is recommended until spring, and a sulfuric acid scarification prior to planting may be helpful. Specific seed treatment procedures were not available for woolly croton. Plant in a loose soil. Fertilizer is required only if the site is excessively sterile and a

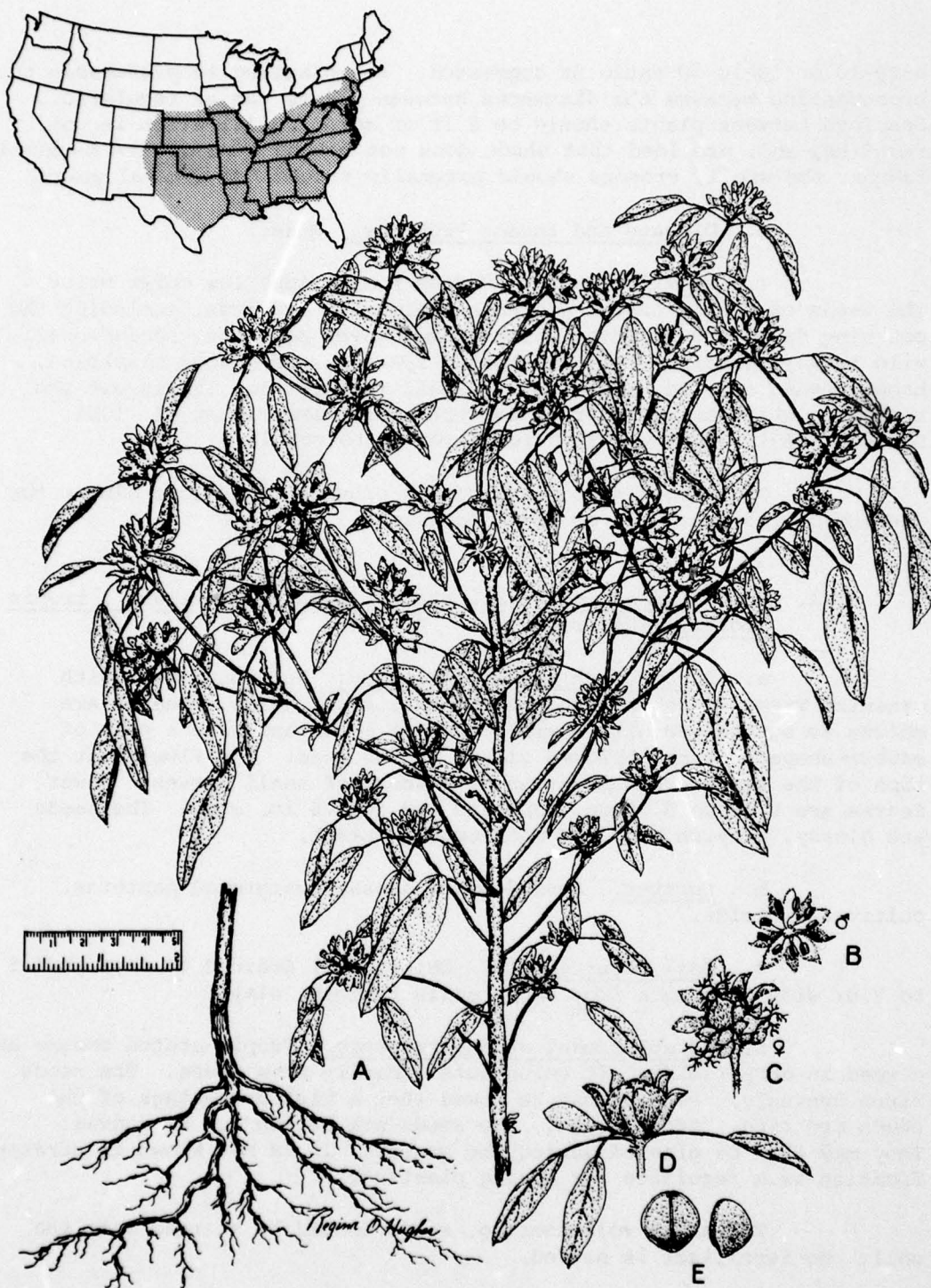


Figure 60. *Croton capitatus*, woolly croton. A, habit x 0.5; B, staminate flower x 1.5; C, pistillate flower x 1.5; D, fruit x 1.5; E, seeds x 2.5.

5-10-10 or 10-10-10 ratio is suggested. Row planting is preferable to broadcasting because the distances between plants can be regulated. Spacings between plants should be 2 ft or more. Cultivation is not required, and, provided that shade does not become a major environmental factor, the woolly crotons should naturally reseed for several years.

e. Disease and Insect Problems. None.

f. Wildlife Value. Medium food value; low cover value. The seeds of woolly croton are eaten primarily by birds, including the mourning dove, ground dove, white-winged dove, bobwhite, scaled quail, wild turkey, cardinal, white-throated sparrow, red-winged blackbird, brown-headed cowbird, and others. Small mammals also likely eat the seeds and white-tailed deer browse the plants (Martin et al. 1951, Davison 1967). Woolly croton is poisonous to cattle.

The robust herbaceous plants provide minor concealment for feeding or resting birds or small mammals.

241. *Croton glandulosus* var. *septentrionalis* Muell-Arg., tropic croton. (Figure 61)

a. Description and Life History. An annual weed with greenish stems which are rough with small stiff hairs. Leaves are oblong to egg shaped with sharply toothed edges and with a pair of saucer-shaped, orange-colored glands at the base. The flowers at the tips of the stems are surrounded by a whorl of small leaves. Lower leaves are 0.75 to 3.75 in. long and 0.2 to 1.6 in. wide. The seeds are glossy, grayish tan, and mottled with black.

b. Habitat. Sunny; waste areas, overgrazed pastures, cultivated fields.

c. Soil Requirements. Moist, well drained to dry; pH 5.5 to 7.0; wide tolerance from sandy soils to loam, clay.

d. Establishment and Maintenance. Tropic croton occurs as a weed in crop fields. It volunteers annually from seeds. The seeds ripen unevenly. Plants must be mowed when a high percentage of the seeds are ripe. After drying, the seeds are beaten out on canvas. They may then be planted during the winter. It is not known if stratification is a requisite for spring plantings.

To induce volunteering, seeds should be stirred into the soil. No fertilizer is needed.

e. Disease and Insect Problems. None.

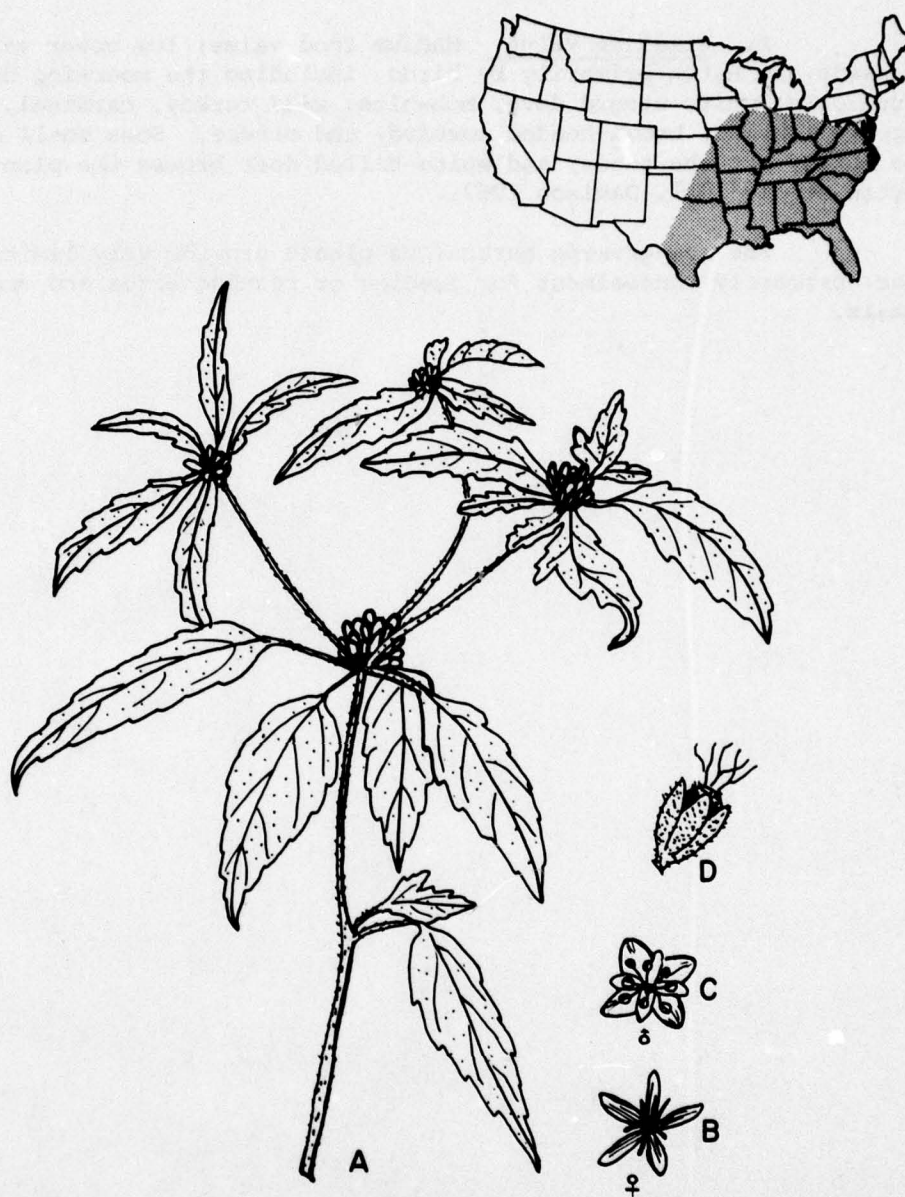


Figure 61. *Croton glandulosus*, tropic croton. A, habit x 0.75; B, female flower x 3; C, male flower x 1; D, fruit x 5.

f. Wildlife Value. Medium food value; low cover value. The seeds are eaten primarily by birds, including the mourning dove, ground dove, white-winged dove, bobwhite, wild turkey, cardinal, red-winged blackbird, brown-headed cowbird, and others. Some small mammals also likely eat the seeds, and white-tailed deer browse the plants (Martin et al. 1951, Davison 1967).

The low-growing herbaceous plants provide very limited cover, primarily concealment for feeding or resting birds and small mammals.

242. Genus *Cyperus*, galingales, umbrella-sedges. A large genus of tropical and temperate regions, the galingales are grass-like plants usually found in moist sands or marshes. The stems are triangular and leafy at the base except for three modified bracteate leaves which subtend the flower heads. Galingales frequently reproduce vegetatively, sending out tough wiry rhizomes from a swollen or bulbous base, the rhizomes either producing new plants or tubers which later produce new plants. The seeds are typically three-angled and oblong, pointed at the apical end, yellowish or yellowish brown at maturity, and highly nutritious. Many species may occur naturally on dredged material sites, and most have some value for wildlife. The most promising species for wildlife habitat development on dredged material is chufa (*Cyperus esculentus*), a species widely used for wildlife food plantings.

243. *Cyperus esculentus* L., chufa. (Figure 62)

a. Description and Life History. A yellowish, perennial sedge with smooth, three-angled stems to about 2 ft tall. Leaves are mostly basal with two or three leaf-like bracts diverging at the diffuse seed head; at least one of these bracts is noticeably longer than the longest fruit stalk. Leaf bases are yellowish tan and fibrous just above the roots. Just beneath the soil surface at the base of the plant a bulb is formed by swelling of the stem. Rhizomes spread from this bulb in all directions to depths of 2 ft and terminate in numerous brown tubers. Because of vegetative reproduction by these tubers, in addition to a prolific seed production and rapid growth of the seedlings, a dense ground cover can be established quickly. The principal wildlife value of chufa, however, is not the cover but the tuber and seed foods.

b. Habitat. Full sun or partial shade of cultivated crops; common in cultivated fields, especially slight depressions where water may stand temporarily after summer showers, around field margins, roadside ditches and other grassy, frequently disturbed sites.

c. Soil Requirements. Wet to moist; pH 5.5 to 8.0; sandy loams and sands.

d. Establishment and Maintenance. Seeds can be obtained by collecting fruiting stems, allowing them to dry, and threshing the stems over a canvas or suitable container. The usual propagation method is by tubers which may be acquired from commercial sources or collected and planted in 42-in. rows in May, June, or July. About 35 lb is required to plant an acre. A fertilizer, such as 8-8-8 or 10-10-10, should be applied to the soil as needed prior to planting. If seedlings are available, they can be set in rows by mechanical planter. Light cultivation as one would perform for other row crops will aid in keeping competing vegetation from surpassing the young plants. Once the plants are established, they will naturally reseed and form tubers. During one study, a single tuber planted in a field produced 1900 plants and 7000 tubers in 1 year (Holm et al. 1977).



Figure 62. *Cyperus esculentus*, chufa. A, habit x 0.5; B, spikelet x 5; C, achene x 10.

e. Disease and Insect Problems. There are few documented cases of insect and disease problems. The insect *Bactra verutana* attacks the plants; the growth of chufa begins in February or March, and the insect does not become active until early July. Injured plants may continue to reproduce.

f. Wildlife Value. High food value; medium cover value. Wildlife relish both the seeds and tubers of chufa, and this plant is commonly used for wildlife enhancement for both waterfowl and various upland game animals, especially wild turkey. Davison (1967) says that the tubers are a choice food of the sandhill crane, mottled duck, Canada goose, mallard, pintail, and wild turkey and are a fair food of the common crow, black duck, ring-necked duck, wood duck, gadwall, boat-tailed grackle, lesser scaup, shoveler, blue-winged teal, green-winged teal, and American wigeon. Martin et al. (1951) list 23 users of chufa and other *Cyperus* species; however, this list is incomplete.

The cover value of chufa depends on the density of the stand; it sometimes provides dense low cover for small mammals and birds.

g. Comments. A related species, purple nutsedge (*Cyperus rotundus*), is considered to be the "world's worst weed" (Holm et al. 1977). This species is often found growing with chufa. Both species will be used by wildlife, but in view of the serious problem with purple nutsedge in agricultural areas, it is not recommended as an alternate choice for planting. In addition to the wildlife value of chufa, the tubers are used in some areas (outside the U. S.) as a human food crop. It is also grown for pig feed. When roasted, the tubers can be used as a coffee substitute, and its oil is similar to olive oil.

244. Genus *Erodium*, filarees. Filarees have been introduced from the Mediterranean region. They are abundant in the far West and have major importance for western wildlife. Only one species occurs in the eastern two-thirds of the country. The most important species are big filaree (*Erodium botrys*), musk filaree (*Erodium moschatum*), and common filaree (*Erodium cicutarium*). The common filaree, the most widespread, is discussed below, but others may also be suitable for wildlife habitat development.

245. *Erodium cicutarium* (L.) L'Heritier de Brutelle, common filaree. (Figure 63)

a. Description and Life History. An introduced, semierect to procumbent winter annual with 4- to 20-in. stems. Numerous branches radiate from the crown of a taproot. The parsley-like compound leaves are pubescent, 2 to 4 in. long. Pinkish-purple flowers specked with purple and about 0.6 in. wide appear in terminal groups of six to nine from February to June. The ice-pick or stiletto-shaped fruit composed of five seeds ripens from April to July. As the seeds dry they spring away from the long central column to which they are attached. The long tails on the seeds rapidly wind into a spiral as soon as they are detached from the central column.

b. Habitat. Full sun; cultivated fields, waste places, lawns.

c. Soil Requirements. Well drained to dry; pH 5.5 to 7.0; sandy loams, loams, clays.

d. Establishment and Maintenance. No apparent information on propagation. Collect mature plants before the seeds ripen and disperse. Dry the plants over canvas to collect the seeds. Plant the seeds by hand, cover shallowly with soil, and firm.

e. Disease and Insect Pests. None.

f. Wildlife Value. High food value; low cover value. The seeds of filarees are eaten by many kinds of birds and small mammals, and the foliage is relished by various browsers. Martin et al. (1951) list 50 users for the genus *Erodium*; all animals listed likely use common filaree. Filaree seeds and foliage are eaten by such important game birds as the California quail, Gambel quail, mountain quail, scaled quail, and wild turkey and by various small mammals (ground squirrels, gophers, kangaroo rats). Many songbirds feed on the seeds and mule deer browse the plants.

The plants provide only minor cover for ground-feeding birds and small mammals.

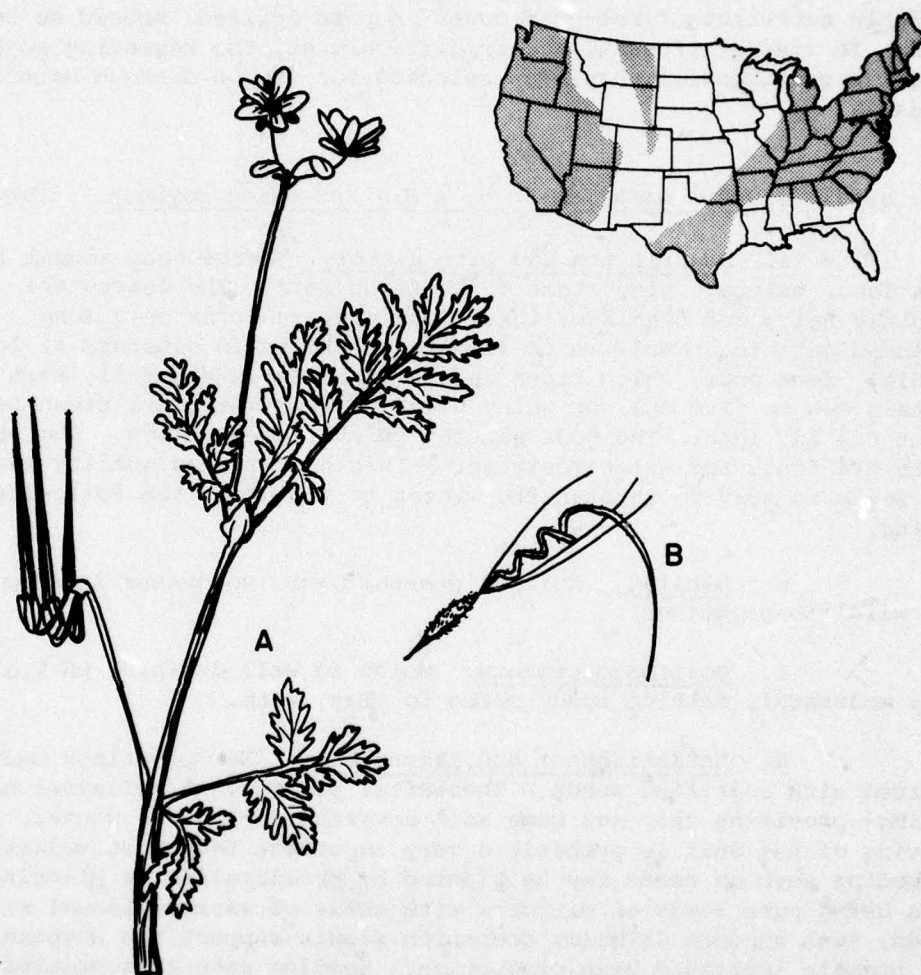


Figure 63. *Erodium cicutarium*, common filaree. A, habit x 1.5; B, fruit x 3.

246. Genus *Glycine*, soybeans. Introduced from eastern Asia, the cultivated agricultural soybean (*Glycine max*) is the most widely distributed and also the widely used wildlife crop of this genus. Although the first-year crop is prolific, the plants seldom reseed and therefore have to be replanted annually. The use of this species on dredged material sites where access by planting equipment is feasible, and where a highly nutritious first-year cover crop is desired, should be considered. In view of presumed access difficulties, the reseeding soybean (*Glycine ussuriensis*), has been selected for use on dredged material sites.

247. *Glycine ussuriensis* R. & M., reseeding soybean. (Figure 64)

a. Description and Life History. Herbaceous annual legume with long, twining, viny stems to 10 ft or more. The leaves are slightly hairy and beanlike; three leaflets are borne on a long extended petiole. Small white flowers are borne in clusters at leaf axils. Seed pods, which ripen indeterminately in mid-fall, each contain two to five dull or shiny black or sometimes dark-brown beans about 0.4 in. long. The pods shatter quickly upon drying. The seed coats are tough and water resistant. This hard-seeded quality enables the seeds to survive through the winter to volunteer the following spring.

b. Habitat. Full to one-half sun; volunteer in crop fields and wildlife plantings.

c. Soil Requirements. Moist to well drained; pH 5.0 to 7.5; moderately fertile sandy soils to clay, loam.

d. Establishment and Maintenance. New plantings must be started with scarified seeds. Thereafter plants will volunteer each spring--providing they get some soil covering during the winter. Frost heaving of the soil is probably a very important factor in volunteering. Reseeding soybean seeds may be planted by broadcasting or planting in rows using pure seeds or mixtures with seeds of various annual wildlife foods, such as corn or milo; companion plants support the soybean vines and promote increased bean production. Seeding rate is approximately 18 lb per acre when broadcast or 10 lb per acre when planted in 36- to 40-in. rows.

Maintenance may require the use of some fertilizer if growth is not satisfactory; a grade high in phosphorous and potassium should be used. Volunteer germination begins in early spring. Sparse stands can be rejuvenated by light disking.

Reseeding soybean is sometimes planted in the middles of corn rows in drained duck fields. In fall, fields may be flooded making both beans and corn available for ducks. Fields are drained in the

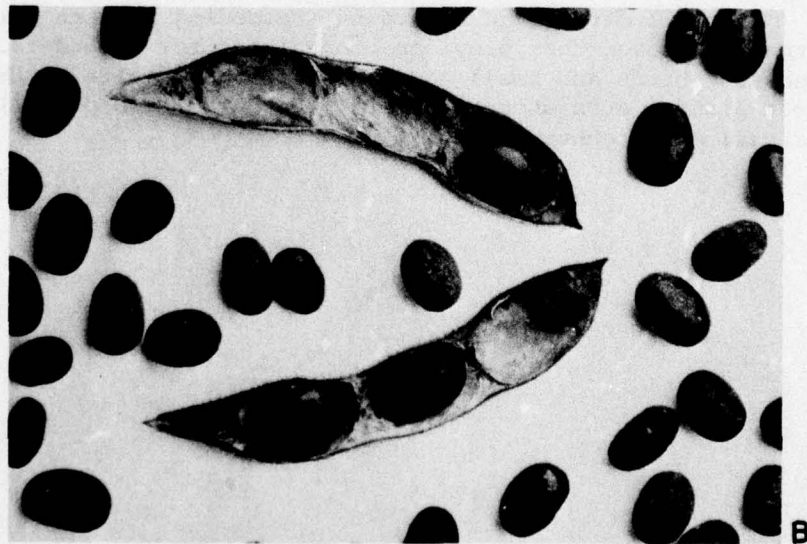
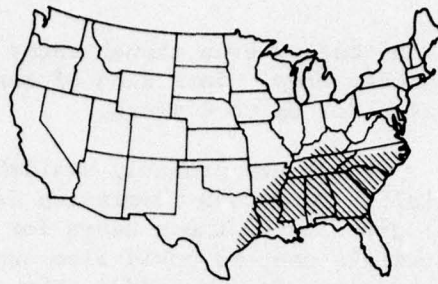


Figure 64. *Glycine ussuriensis*, reseeding soybean. A, habit; B, seed pods and seeds. (N. C. Wildlife Resources Commission photos)

spring. The beans, even though under water all winter long, come back as a volunteer crop. This kind of management has been continued successfully for up to 6 years.

Seeds are probably available from commercial sources. The N. C. Wildlife Resources Commission (and perhaps other state wildlife agencies) distributes these seeds for wildlife plantings. Some SCS plant materials centers could also supply initial seed stock. To obtain seed stock from existing stands, the soybeans must be combined when a high percentage of the pods are ripe but when some are still green and a few are beginning to shatter.

e. Disease and Insect Problems. None.

f. Wildlife Value. Medium food and cover value. For the agriculturally grown soybean (*Glycine max*), Martin et al. (1951) list only 11 users. However, increased cultivation of soybeans in recent years has led to increased acceptance and use by wildlife. The wildlife species which use agriculturally grown soybeans also would likely use the reseeding soybean as well. The reseeding soybean is often used as a wildlife planting. The seeds are the primary attraction and are eaten by upland game birds such as the mourning dove, wild turkey, bobwhite, and ring-necked pheasant and probably by many small rodents. Cottontail rabbits and white-tailed deer feed on the plants. Waterfowl, primarily Canada geese and various surface-feeding ducks feed in soybean fields and presumably would feed on reseeding soybeans as well if they were available.

As illustrated in Figure 64, reseeding soybean furnishes low, herbaceous cover that provides concealment for ground-feeding or ground-nesting birds and small mammals. If planted with higher growing herbaceous plants, such as corn or milo, both the seed production and the cover value are enhanced.

248. Genus *Helianthus*, sunflowers. About 60 species of sunflowers occur throughout the country in a wide variety of habitats. One species, Maximilian's sunflower (*Helianthus maximiliani*) is discussed below, but many additional species may also be suitable for establishment on dredged material areas. Sunflower seeds are a nutritious food readily eaten by game birds, songbirds, and rodents and are especially valuable to wildlife in the prairies and other parts of the West.

249. *Helianthus maximiliani* Schrader, Maximilian's sunflower.
(Figure 65)

a. Description and Life History. Herbaceous perennial to 6 ft with upright, stout, rough stems. The pointed leaves are also rough, 3 to 7 in. long, alternate with lower ones mostly opposite each other on the stem. The 2- to 3-in. broad flower heads are showy with yellow petals and disk. Seeds are wedge shaped, gray mottled with black, flattened, and about 0.25 in. long. The plant spreads slowly from thickened root-stocks to form dense rounded mats.

b. Habitat. Full sun; dry prairies, old pastures, cultivated fields.

c. Soil Requirements. Moist to dry; pH 5.5 to 7.5; sandy soils to loam, silt, clay.

d. Establishment and Maintenance. Seeds are spring planted in 36- to 40-in. rows at a rate of about 20 per foot. They are covered with 0.25 to 0.5 in. of soil. Plants may also be established by digging and dividing the root stocks. Since this species prefers well-drained sites, it should not be considered for poorly drained dredged material. Because of their height, they are best grown in groups with low vegetation or with bare areas beneath.

e. Disease and Insect Problems. None.

f. Wildlife Value. High food value; low cover value. Records of use of specific species of sunflowers are lacking. However, Davison (1967) lists approximately 50 birds for which sunflower seeds are a choice or fair food, and Martin et al. (1951) list 60 wildlife users, mostly birds and small mammals which feed on the seeds of plants of genus *Helianthus*. Upland game birds such as the mourning dove, white-winged dove, sharp-tailed grouse, ring-necked pheasant, bobwhite, Harlequin quail, and scaled quail and songbirds such as the red-winged blackbird, yellow-headed blackbird, common crow, and various goldfinches, sparrows, grosbeaks, and nuthatches all relish the seeds (Martin et al. 1951, Davison 1967). Small mammals (mice, rats, chipmunks, ground squirrels) feed on the seeds, and white-tailed deer, mule deer, and antelope browse on the plants. Maximilian's sunflower offers very little cover for wildlife unless grown in dense stands.



Figure 65. *Helianthus maximiliani*, Maximilian's sunflower. A, plant in flower; B, disk flower; C, ray flower.

250. Genus *Lathyrus*, vetchling, wild pea. In the U. S., *Lathyrus* is a widespread genus composed of about 45 native and a dozen introduced species of diverse habitats found commonly in cool regions and in the West. Among the many cultivated varieties is the sweet pea. Most members of the genus are trailing or weakly erect herbs with showy flowers and bluish-green foliage. They are good soil-improving crops.

251. *Lathyrus palustris* L., marsh pea. (Figure 66)

a. Description and Life History. A perennial sprawling vine with winged or wingless stems that may be 3 to 4 ft long. Leaves have four pair of elliptic leaflets; the terminal leaflet is replaced instead by a branched tendril. At the base of the compound leaves is a characteristic foliar pair of bracts, the stipules, which somewhat surround the stem and have pointed basal lobes. Flowers which appear from May until June are reddish purple. The seed pod is smooth, slightly more than 2 in. long, and about 0.3 in. wide. The enclosed five to eight seeds ripen from July to September.

b. Habitat. Partial shade; stream banks, bottomland woods, shores, wet thickets, meadows.

c. Soil Requirements. Wet to moist; pH 6.5 to 7.7, low pH in the southern part of its range and high pH in the northern part; muck, peat, sands, and soils derived from limestone.

d. Establishment and Maintenance. Plants should be started from seeds. To obtain seeds, mechanical harvesting of mowed and field-dried plants is required. Commercial sources may be available. Seeds should be drilled or broadcast in the fall on a seedbed that is free from weeds. The best planting time is usually mid-September to mid-October. Scarified seeds, planted at the rate of 20 lb per acre will yield a good stand. Once the marsh peas are established, reseeding will occur and plantings need not be repeated. Addition of lime to the soil will usually increase yields in areas with naturally acidic soils. Depending upon soil fertility, application of superphosphate and in some areas potash may increase yields. The expected production of seeds on fertile soils is approximately 600 lb per acre (USDA 1948).

e. Disease and Insect Problems. None apparent.

f. Wildlife Value. Food value not well documented, probably medium; medium cover value. Use of this plant by wildlife is not well documented; however, it is probably consumed by the species known to utilize flat pea (*Lathyrus sylvestris*) discussed in the following section, as well as small mammals. The moose and snowshoe hare are known to browse on marsh pea (Graham 1941), and it is consumed by California Quail in Oregon (personal communication, Dr. John Crawford, Oregon State U.).

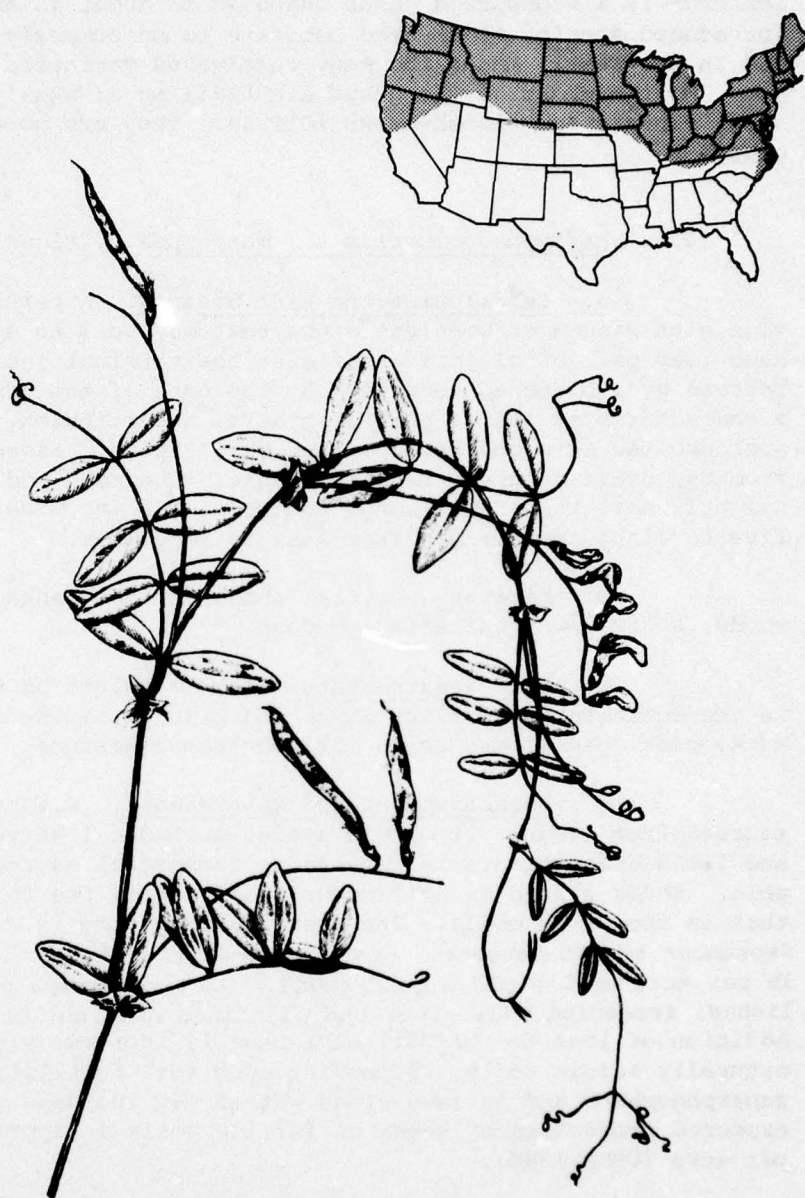


Figure 66. *Lathyrus palustris*, marsh pea. Habit x 1.

252. Lathyrus sylvestris L., flat pea. (Figure 67)

a. Description and Life History. An herbaceous perennial vine which dies to the ground in the winter. The stems, if supported, will attain a height of 6 to 7 ft. Normal stands form a dense vegetative mat 18 to 30 in. in height. The stems and leaf petioles are winged, the latter surmounted by a pair of long narrow leaves with parallel veins. A tendrill extends from the base of these two leaves. Flowers are deep pink to reddish brown. Seeds are round and black and borne in pods 2 to 3 in. long.

b. Habitat. Sun to partial shade; on poor sterile problem sites.

c. Soil Requirements. Moist to dry; pH 5.5 to 6.8; sands, gravels, soils from acid sandstones to fine-textured soils.

d. Establishment and Maintenance. Flat pea seeds must be inoculated with a specific inoculant for *Lathyrus* (sweetpea and peas) before planting. Germination and initial growth are quite slow. To get quicker erosion protection, 30 lb of peas may be mixed with 8 to 10 lb of ryegrass or 10 to 15 lb of tall fescue and broadcast per acre. Wheat, oats, barley or rye may be used in the same way using about half the normal broadcast rates for the small grain. Cereal rye (Abruzzi variety preferred) is best for very sandy excavated material. There are two preferred methods for planting flat peas with small grains. Either sow grain in 16- to 30-in. rows among a broadcast planting of flat peas or plant the flat peas in single rows between the rows of grain. The best time for planting is early spring. Depth of planting will range from 2 in. on sand to 0.5 in. on the heavier soils. If possible, the required fertilizer should be worked into the soil before planting. The correct fertilizer for legume-grass seedings is 0-20-20.

Little or no maintenance is required. Mowing to control invading unwanted vegetation is acceptable if done once a year just after full bloom. Cutting height is 6 in. (USDA-SCS 1969-1976).

e. Disease and Insect Problems. None.

f. Wildlife Value. Food value not well documented, probably medium; high cover value. Flat pea provides good cover for wildlife such as deer and small game species. Pigeons, doves, grouse, and wild turkey are known to utilize the seed (USDA-SCS 1969-1976).

g. Comments. The above information was taken primarily from "Plants for Conservation in the Northeast" (USDA-SCS 1969-1976). Development in the use of this plant took place at the SCS Plant Materials Center, Big Flats, N. Y. "Lathco" is the only named variety. Supplies of seeds are available (but limited) in New York and Pennsylvania.

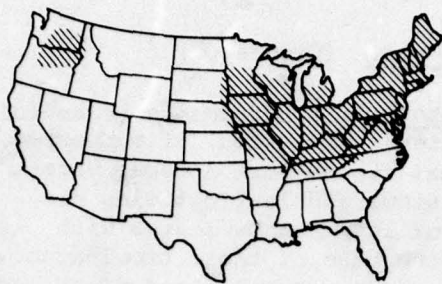


Figure 67. *Lathyrus sylvestris*, flat pea. Habit x 0.5.

253. Genus *Lespedeza*, lespedezas. *Sericia lespedeza*, described below, is treated as a herbaceous plant since it dies to the ground each winter. There are several other important herbaceous annual lespedezas that are cultivated for their use for forage, wildlife food, cover, and erosion control and that may be suitable for use on dredged material. Foremost of these are Japanese clover (*Lespedeza striata*), found from Pennsylvania to Kansas and south to the Gulf of Mexico, and Korean clover (*Lespedeza stipulacea*), which ranges from Pennsylvania to Iowa and southward to Alabama and Georgia. The growth habits of both are very similar. They are easily grown from seeds and produce a very dense low cover on relatively poor soils and eroded sites. Seed production is excellent and both species are recognized as extremely important foods for the bobwhite quail. Surprisingly, the use of lespedezas by songbirds is slight. However, Martin et al (1951) report that the mourning dove, grouse, chukar partridge, and wild turkey also take the seeds in limited quantities and that the foliage is an important summer deer browse.

254. *Lespedeza cuneata* (Dumont) G. Don, sericea lespedeza.
(Figure 68)

a. Description and Life History. A perennial herb from a woody crown usually with several erect stems 2 to 3 ft tall which branch freely near the top. Foliage is dense and fine, with an almost fernlike appearance. The stems are ridged lengthwise and finely hairy. Leaves are compound, each composed of three leaflets which are linear or oblong, blunt near the tip, ending with a small spur, greenish silver with short hair, 0.4 to 1 in. long, and less than 0.25 in. wide. Small creamy-white flowers, closely clustered at the upper branch ends, appear in July and August. The seeds which ripen just ahead of frost in October and November are about 0.09 in. long. Seed coats are hard, shiny yellow, and slightly speckled with brown.

b. Habitat. Full sun to half shade; pastures, hayfields, soil erosion control plantings on road banks, powerline rights-of-way, etc.

c. Soil Requirements. Moist to dry; pH 4.5 to 7.5; sands, sandy soils, to loams, silts, clays, eroded soils.

d. Establishment and Maintenance. *Sericia* is always established from seeds. For normal spring plantings the seeds are cleaned, scarified mechanically, and planted a week or two before the last expected frost. The planting rate is 30 to 40 lb per acre on a prepared seedbed. For wildlife work the rate may be reduced to 20 lb with the addition of various adapted grass seeds at half their normal seeding rate. These combinations can be selected to improve the wildlife food and/or cover value. All seeds may be broadcast or drilled or even planted in spaced rows.

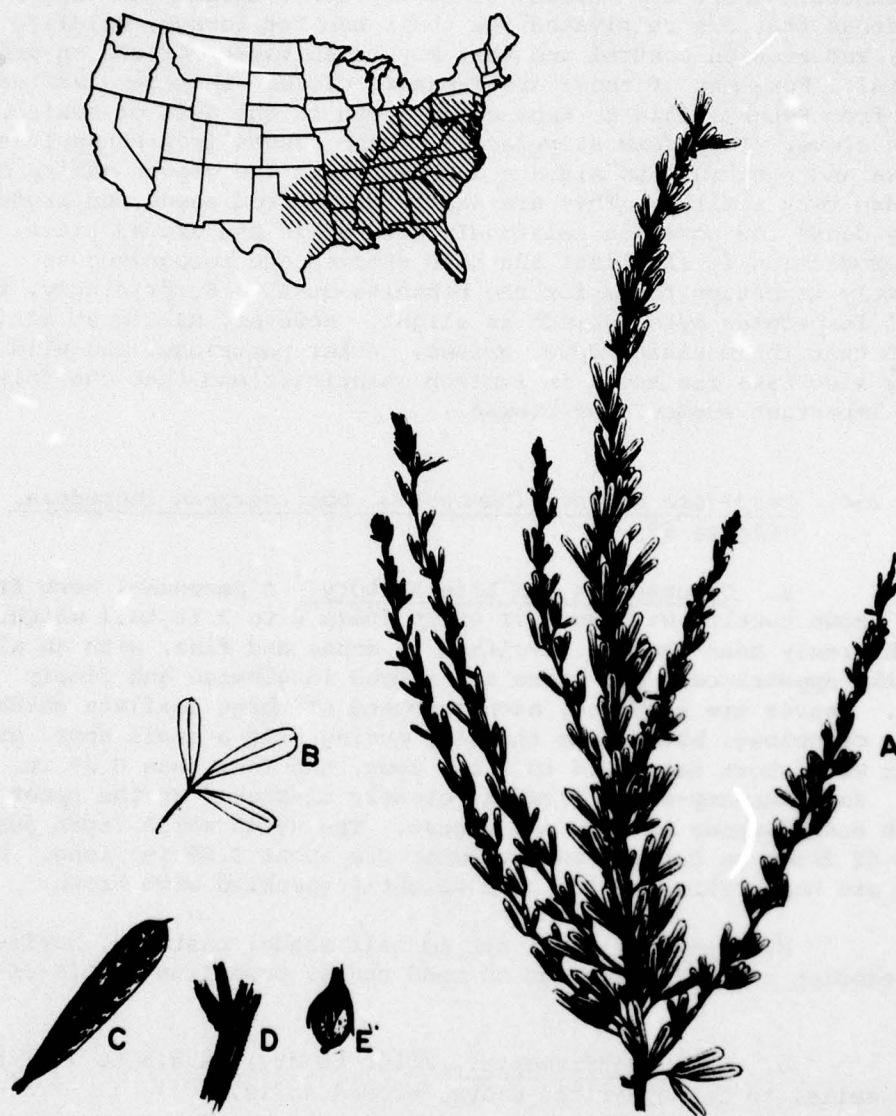


Figure 68. *Lespedeza cuneata*, sericea lespedeza. A, habit x 0.5; B, leaf x 1; C, leaflet x 2; D, enlarged section of stem x 2; E, fruit x 3.

Sericea may also be planted during other seasons of the year by using uncleaned, unscarified seeds called "combine run". For example, these seeds may be included in an early fall planting of small grain, tall fescue, etc., or included with a summer sowing of browntop millet, proso millet, etc. Most of the unscarified seeds remain in the soil without sprouting until their proper time in the spring.

On well-drained to dry sites it is important to plant on a firm seedbed. Seeds are planted about 0.5 in. deep. If planted on acid soils below a pH of 5.5, lime will be needed at planting time and thereafter at 5-year intervals. Mixed plantings (grass-sericea) will benefit from applications of 5-10-10 fertilizer. Pure sericea plantings are satisfied with 0-14-14. Depending upon the condition of the dredged material, fertilization or liming may not be necessary. To prevent an invasion of pest plants, sericea may be mowed; this should be done only during the dormant season.

e. Disease and Insect Problems. Sericea is fairly resistant to disease and insects. Grass armyworms, stem girdlers, and three-horned alfalfa leafhoppers are known to attack sericea, but no serious problems would be expected on dredged material sites.

f. Wildlife Value. Low food value, medium to high cover value. The seeds of sericea lespedeza are available throughout the winter but are known to be eaten only by a small number of wildlife species, including the bobwhite, slate-colored junco, eastern bluebird, oldfield mouse, and cotton rat. The plants are also eaten by eastern cottontails (Graham 1941).

Sericea lespedeza often forms a dense ground cover which provides concealment for nesting, resting, and feeding small mammals and birds. It is often used for bobwhite quail management, primarily due to its cover value for nesting sites.

g. Comments. Sericea first came into use in this country in the early 1930's. It was tested and then produced in huge quantities by USDA-SCS. Sericea has been applied successfully on all kinds of critical erosion sites and also as a productive hay, grazing, and seed crop on farms with poor, usually dry, or eroded soils. It is used extensively for road bank erosion control and for bobwhite management.

255. Genus Medicago, bur-clovers and medicks. Approximately half a dozen annual and perennial species of *Medicago* have been introduced into this country from Europe, Asia, and Africa. Several, such as spotted bur-clover (*Medicago arabica*) and alfalfa (*Medicago sativa*), have been extensively planted for crops, pasturage, and soil improvement. These plants are valuable as winter cover and green manure crops, and the seeds and foliage are consumed by a variety of wildlife species. The bur-clovers and medicks are particularly abundant on the Pacific coast, and it is there that they are of greatest wildlife value.

256. *Medicago lupulina* L., black medick. (Figure 69)

a. Description and Life History. An annual, sometimes acting as a perennial, with a shallow taproot. The four-angled, slightly hairy, prostrate stems are from 4 to 16 in. long. The clover-like, three-parted compound leaves are sparingly hairy. The central leaflet has a short stalk. The obicular to obovate leaflets are 0.2 to 0.6 in. long. Small, 0.16-in. long, yellow flowers are crowded into spikelike clusters up to 0.5 in. long. Flowers are commonly produced from March to September; however, in very warm regions black medick may flower throughout most of the year. One-seeded, hairy, nearly kidney-shaped legumes are produced continually during the flowering period. The 0.08-in.-long seeds are generally a dull black or dark brown at maturity. In the deep south plants go dormant in summer.

b. Habitat. Full sun; roadsides, lawns, pastures, waste places, forage plantings.

c. Soil Requirements. Well-drained to dry; pH 4.5 to 7.0; sand, sandy soils, loams; widely adaptable to well-drained, moderately fertile soils.

d. Establishment and Maintenance. The seeds are sometimes available commercially. Seeds can be collected after they ripen and fall to the ground. Both cleaned and uncleaned seeds should be stored dry. Before planting in the fall, inoculation with a proper bacteria may be advantageous if legumes have not been previously grown on a site. Seeds should be planted 3 weeks before the first fall frost, and they may be broadcast or sown in rows. Whichever method is used the seeds should be covered with 0.5 to 1 in. of soil. Black medick seeds can be mixed with other fall-sown seeds. It reseeds readily. Like alfalfa and the other medicks, black medick will benefit from application of lime; though lime is not essential, seed yields will benefit.

e. Disease and Insect Problems. None.

f. Wildlife Value. Low to medium food value; medium cover value. The seeds of black medick have been found in the stomachs of the black duck, fulvous tree duck, Hungarian partridge, and ring-necked

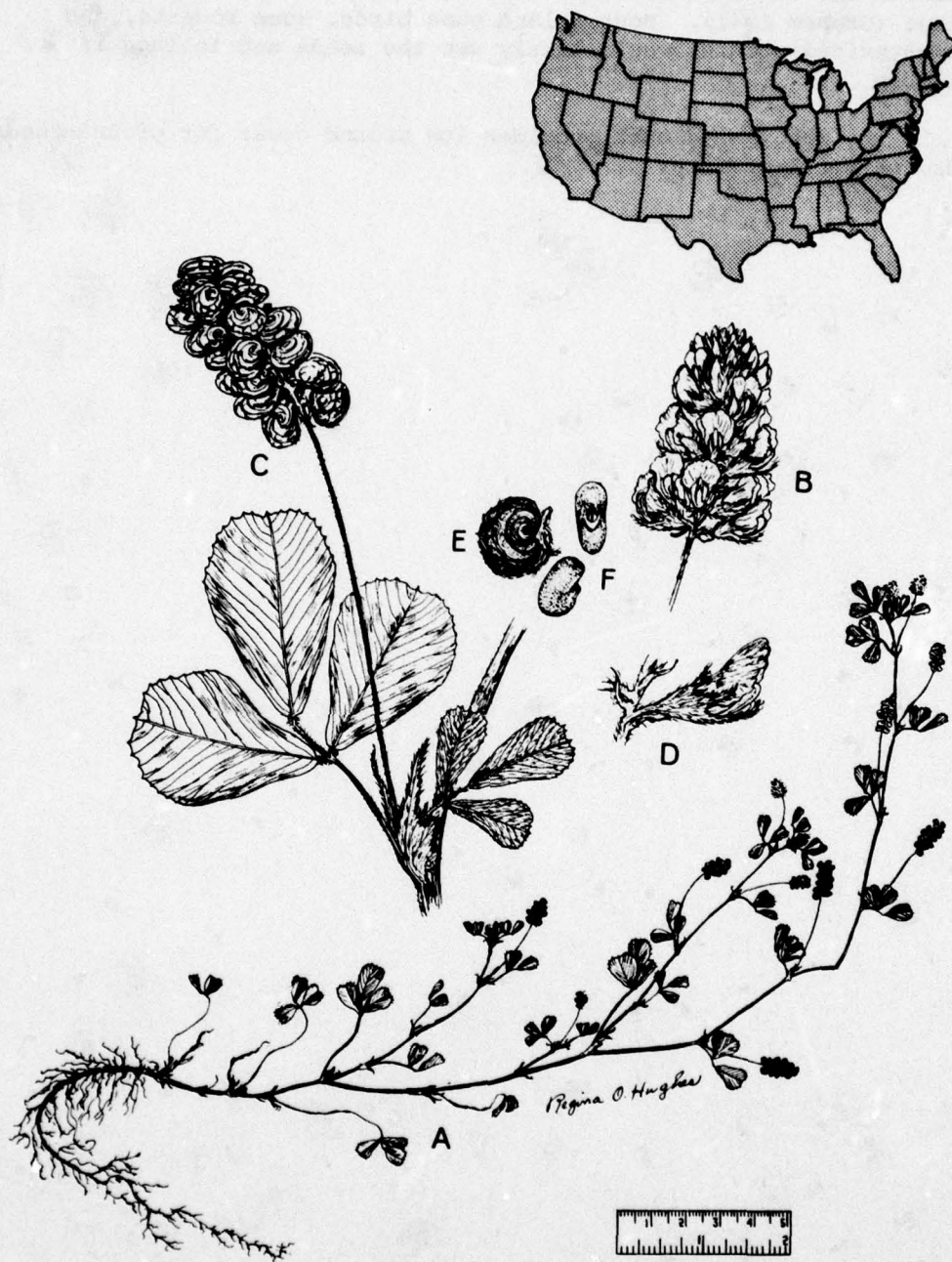


Figure 69. *Medicago lupulina*, black medick. A, habit x 0.5; B, flower raceme x 6; C, fruiting raceme x 3; D, flower x 10; E, legume x 5; F, seeds x 5.

pheasant; the white-tailed deer and mule deer are known to eat the foliage (Graham 1941). Most upland game birds, some rodents, and some waterfowl species would likely use the seeds and foliage if available.

The lush growth provides low ground cover for ground-feeding birds and small mammals.

257. Genus *Phytolacca*, pokeweeds. Pokeweed (*Phytolacca americana*) is the best known species of *Phytolacca* in the United States, though there are many other species in the tropics. In many parts of the Southeast pokeweed is regarded as a noxious weed.

258. *Phytolacca americana* L., pokeberry. (Figure 70)

a. Description and Life History. A robust perennial herb 3 to 9 ft tall and with several stems from an enlarged fleshy to fibrous root stock. The stems are wide-branching and irregular above, fairly open below, green becoming red as they mature, and fleshy and hollow. Roots are thick and fleshy. Leaves are smooth, lance-shaped without serrated margins, 3 to 12 in. long, and 1 to 4.75 in. wide. Leaves alternate on the stems and are attached by short stalks 0.38 to 2 in. long. In May hanging clusters of greenish-white flowers are borne on purple stalks. Purple-black berries approximately 0.25 in. in diameter mature at frost and contain 5 to 12 lustrous, black, flattened seeds. Pokeberry is a short-lived perennial.

b. Habitat. Full sun to half-shade; waste ground, pastures, around farm buildings, stump piles from clearing operations, other disturbed habitats.

c. Soil Requirements. Moist to well drained; pH 5.0 to 7.0; sandy soils, loams, silts, clays, disturbed rich soils.

d. Establishment and Maintenance. The plants can be grown elsewhere and the fleshy tuberlike roots used to establish plants on the dredged material. It also is possible to plant seeds on the site in a protective grass cover. Berries are collected and cleaned in the fall. After being dried and scarified, the seeds can be planted immediately or stratified and kept over winter until an early spring planting date. Seeding rate is 12 seeds per foot of row, or 15 lb per acre when drilled or broadcast. Planting depth is 0.5 in. Fertilizer may be necessary on some sites to maintain berry production. Pokeberry is more productive on rich soils.

e. Disease and Insect Problems. Susceptible to root-knot nematode, the plants will be short lived in soils where these pests are present. Dredged material would be free of such infestations.

f. Wildlife Value. High food value; low cover value. The dark-purple berries and large, black seeds are a popular food for birds. Davison (1967) states that the fruit is a choice food of the eastern bluebird, cardinal, catbird, common crow, eastern kingbird, mockingbird, robin, starling, summer tanager, brown thrasher, hermit thrush, wood thrush, veery, warbling vireo, hooded warbler, and cedar waxwing and is a fair food of the yellow-shafted flicker, great crested flycatcher, scissor-tailed flycatcher, yellow-bellied sapsucker, fox sparrow, white-throated sparrow, Swainson's thrush, hairy woodpecker,

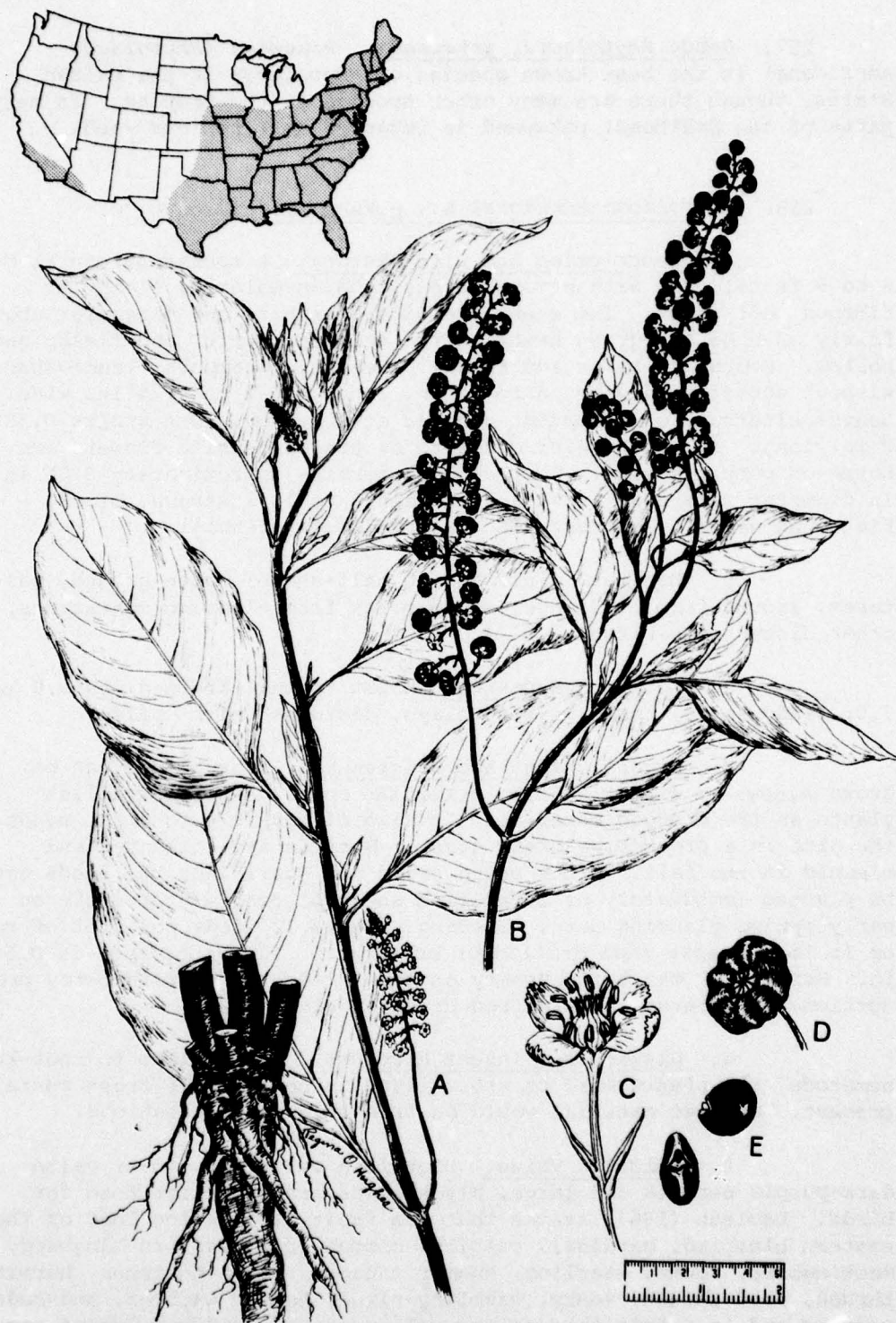


Figure 70. *Phytolacca americana*, pokeberry. A, habit, in flower x 0.5; B, fruiting raceme x 0.5; C, flower x 5; D, berry x 2; E, seeds x 2.5.

red-bellied woodpecker, and red-cockaded woodpecker. He also says that the seeds are a choice food of the mourning dove and cardinal and a fair food of the bobwhite. Martin et al. (1951) list many of the same bird users as well as the yellow-breasted chat, fish crow, rose-breasted grosbeak, phoebe, gray-cheeked thrush, olive-backed thrush, and golden-fronted woodpecker. The fruits also are eaten by the gray fox, red fox, opossum, raccoon, and white-footed mouse.

As individual plants, pokeberry provides only limited cover for wildlife; however, in dense stands which sometimes occur on disturbed soil, the cover value is much greater.

g. Comments. The seeds have a porcelainlike seed coat which is almost waterproof. Seeds can lie in the soil for years without germinating. Germination does not occur until a soil disturbance increases the oxygen supply.

The young leaves can be used as cooked greens, but the older leaves are poisonous.

259. Genus *Polygonum*, knotweeds and smartweeds. The genus *Polygonum* includes typically upland species commonly called knotweeds and typically wetland species called smartweeds. (Some botanists place the smartweeds in a separate genus, *Persicaria*.) Of the two species discussed below, the wild buckwheat (*Polygonum convolvulus*) is an upland species, and the Pennsylvania smartweed (*Polygonum pensylvanica*) is a wetland species which will also grow on moist to well-drained uplands. Depending on the dredged material site, many other species may also be suitable for wildlife habitat development. On moist or wet sites, ladythumb (*Polygonum persicaria*), dotted smartweed (*Polygonum punctatum*), nodding smartweed (*Polygonum lapathifolium*), marshpepper smartweed (*Polygonum hydropiper*), or arrow-leaved tearthumb (*Polygonum sagittatum*) may be used. On drier upland sites, knotweeds, such as prostrate knotweed (*Polygonum aviculare*), may be grown.

260. *Polygonum convolvulus* L., wild buckwheat. (Figure 71)

a. Description and Life History. An annual, herbaceous, twining or creeping vine. The roots are fibrous. The slightly rough to smooth, slender stems are branched from the base and twine around other vegetation or trail along the ground. Plants commonly grow to a height of 3 to 3.5 ft. The 0.8- to 2.5-in.-long, dull green leaves are heart shaped with pointed basal lobes directed backward. Small greenish-white flowers are born in short, axillary clusters from May to November. Three-angled, black seeds about 0.12 in. long are produced as the vine continues to flower. Growth is rapid.

b. Habitat. Full sun; cultivated fields, waste places, thickets, fencerows.

c. Soil Requirements. Moist to well drained to dry; pH 5.0 to 8.0; sandy soils, sandy loams, loams, silts, clays, adaptable to any agricultural soils.

d. Establishment and Maintenance. Wild buckwheat is propagated from seed collected in the summer or fall and planted immediately or stored until the following spring. Seeds can be harvested by removing the upper flowering portions of plants after seeds have begun to mature. After drying over canvas, seeds should be cleared of vegetative debris and allowed to dry somewhat before storing under dry conditions. Fall plantings will not germinate until the following spring. Germination of spring plantings of dried seeds is improved by stratifying for 8 weeks in moist peat moss. Seeds may be broadcast or sown in rows; they should be covered with 0.50 to 1 in. of well-firmed soil. Spring plantings should not be made until after the last frost date. After the initial planting wild buckwheat will reseed itself abundantly; it adapts readily to almost any soil that can be cultivated (Holm et al. 1977).

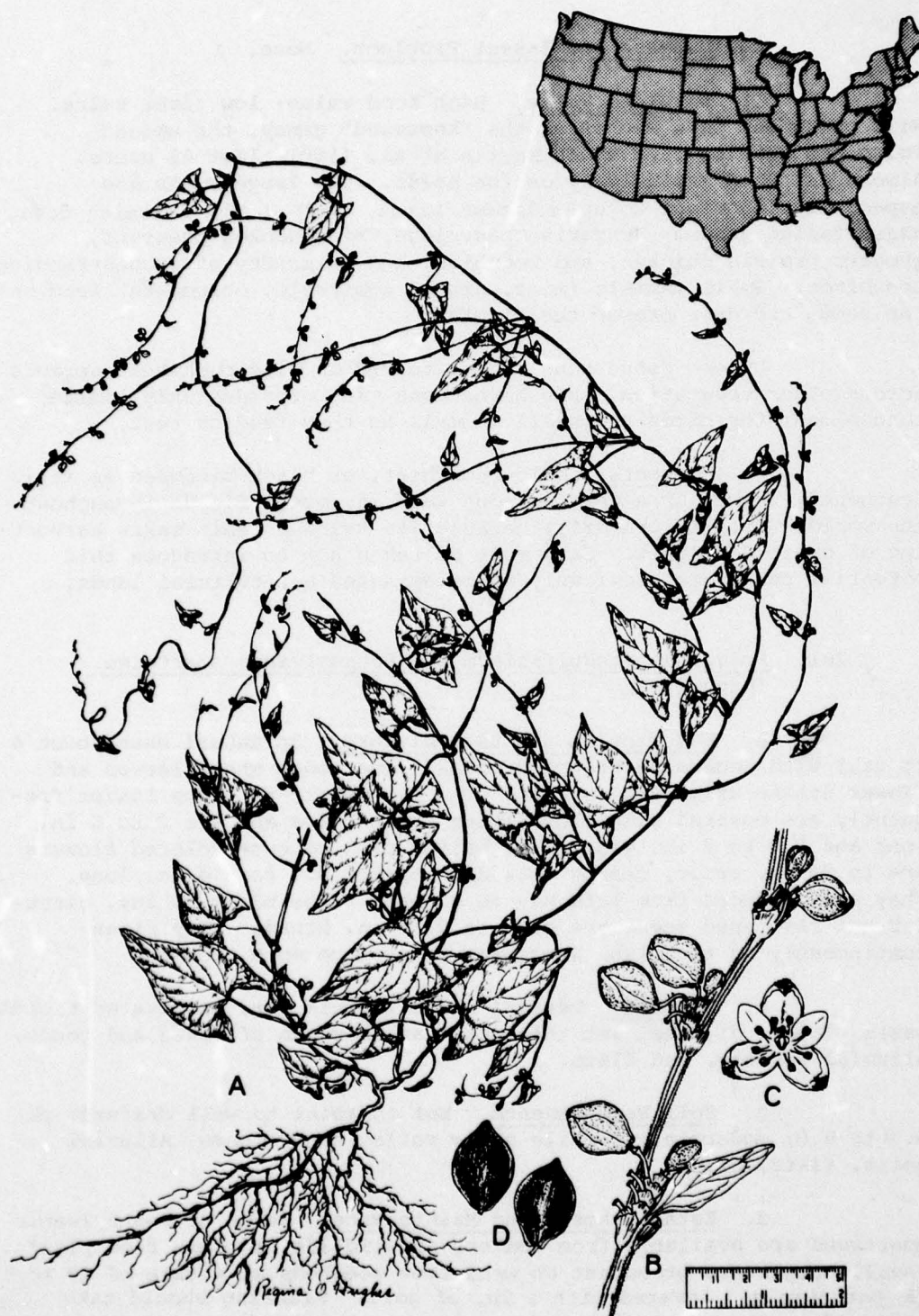


Figure 71. *Polygonum convolvulus*, wild buckwheat. A, habit x 0.5; B, branchlet with fruiting calyx x 4; C, flower x 5, D, achenes x 5.

e. Disease and Insect Problems. None.

f. Wildlife Value. High food value; low cover value. Wild buckwheat is a member of the "knotweed" group, the upland *Polygonum* species, for which Martin et al. (1951) list 61 users. Almost all feed exclusively on the seeds. The large seeds are especially important to upland game birds, such as the mourning dove, sharp-tailed grouse, Hungarian partridge, ring-necked pheasant, greater prairie chicken, and bobwhite, and a variety of ground-feeding songbirds. Small mammals (mice, ground squirrels, chipmunks) feed on the seeds and deer browse the plants.

Unless dense tangles are formed as wild buckwheat sprawls across other vegetation, this herbaceous vine provides only limited concealment for birds and small mammals as they feed or rest.

g. Comments. Wild buckwheat, or black bindweed as it is frequently known, is a very serious weed in cereal fields throughout the world. This is primarily because its twining habit makes harvesting of grain difficult. Care must be taken not to introduce this potential pest into previously uncontaminated agricultural lands.

261. *Polygonum pensylvanicum* L., Pennsylvania smartweed.
(Figure 72)

a. Description and Life History. An annual herb about 4 ft tall with ascending branched stems. The nodes where leaves and flower stalks arise are swollen. The lanceolate to ovate leaves frequently are covered with close-lying stiff hairs and are 2 to 6 in. long and 0.8 to 2 in. wide. The bright pink or rose-colored flowers are in dense, erect, nearly cylindric spikes 0.4 to 2.4 in. long. They are produced from late May to October. The black, shiny, circular but flattened seeds are 0.08 to 0.14 in. broad. They ripen continuously as the plant continues to produce more flowers.

b. Habitat. Partial shade to full sun; cultivated fields, waste places, ditches, wet thickets, damp margins of lakes and ponds, alluvial forests, mud flats.

c. Soil Requirements. Wet to moist to well drained; pH 5.0 to 8.0; moderately fertile sandy soils, sandy loams, alluvial soils, silts, clays.

d. Establishment and Maintenance. Seeds of Pennsylvania smartweed are available from dealers in wildlife and game food plants. Usually seeds are broadcast on weed-free seedbeds at a rate of 10 to 15 lb per acre and covered with 1 in. of soil. Planting should take place after the last killing frost in the spring. Later seedlings can be planted so that ripening of seeds will coincide with the arrival of



Figure 72. *Polygonum pensylvanicum*, Pennsylvania smartweed. A, habit x 0.5; B, spike x 2.5; C, achenes x 4.

specific migratory birds. Mixed plantings of Pennsylvania smartweed and other herbaceous species are particularly satisfactory for upland sites. Plantings on moderately fertile sites produce the best seed crops; application of a fertilizer high in phosphorus, such as 10-20-10, is suggested for large stands on accessible sites. An annual light harrowing is recommended for natural reestablishment (USDA-SCS 1969-1976); otherwise replanting will be necessary to ensure a uniform stand.

e. Disease and Insect Problems. None.

f. Wildlife Value. High food value; medium cover value. The smartweeds are generally wetland species, but some occur on moist uplands as well. Martin et al. (1951) lists 66 users of smartweed. All of these probably use the Pennsylvania smartweed. Almost all users feed exclusively on the seeds. Martin and Uhler (1951) state that Pennsylvania smartweed is a good to excellent waterfowl food. SCS (USDA-SCS 1969-1976) states, "Pennsylvania smartweed is an excellent native wildlife food plant, especially for waterfowl. Twenty species of ducks and geese, bobwhite, mourning doves, ring-necked pheasants, four species of rails, as well as 30 nongame birds, eat the seeds. Dense stands provide excellent cover for young waterfowl, marsh birds, and wintering pheasants. Plants or seeds are eaten by white-footed mice, muskrats, raccoons, and fox squirrels."

262. Genus *Rumex*, sheepsorrels and docks. Sheepsorrel and various docks (about 30 species) are widely distributed throughout the United States, primarily in moist, sunny habitats. Sheepsorrel (*Rumex acetosella*), an abundant weed and by far the most important member of this genus to wildlife, is discussed below. Other species, such as golden dock (*Rumex persicarioides*) and curly dock (*Rumex crispus*), are also used by wildlife and may occur naturally on dredged material areas.

263. *Rumex acetosella* L., sheepsorrel. (Figure 73)

a. Description and Life History. A dioecious rhizomatous, perennial with a rosette of basal leaves. The thick leaves are arrow shaped with two basal lobes and are 1 to 2.8 in. long. Several flowering stems arise from the basal leaves. The minute reddish, yellowish, or greenish male and female flowers are borne on separate plants on the upper third to half of the 4- to 20-in. stalks. Flowering occurs from March to June, and the three-sided shiny, reddish-brown to golden-brown nutlets produced on female plants ripen from May to June. Dense stands of sheepsorrel are distinctly rusty brown in color.

b. Habitat. Full sun; cultivated and worn-out fields, pastures, lawns, roadsides.

c. Soil Requirements. Moist to well drained; pH 4.5 to 7.5; infertile sandy soils, gravelly soils, clays.

d. Establishment and Maintenance. Since sheepsorrel is a dioecious plant it is necessary to hand collect seeds from female plants. Seeds should be collected soon after ripening, dried over canvas, and stored dry until they are broadcast in the early fall. Vegetative propagation by dividing rhizomes in the late winter and early spring or in the fall may be an alternative. If at all possible, more female than male plants should be selected for division.

Sheepsorrel is known to be an indicator of infertile, acid soils. Stands cannot be maintained on fertile soils; application of fertilizers will result in its disappearance. For such problem sites, sheepsorrel is an ideal, highly productive species.

e. Disease and Insect Problems. None.

f. Wildlife Value. High food value; low cover value. Davison (1967) says that sheepsorrel is a fair food of the ruffed grouse, wild turkey, grasshopper sparrow, savannah sparrow, and tree sparrow. Martin et al. (1951) state that sheepsorrel is by far the most important wildlife plant of the genus *Rumex*. They list 35 users of the genus *Rumex*, and it is likely that all those listed (plus others) use sheepsorrel. Many songbirds eat the seeds, and upland

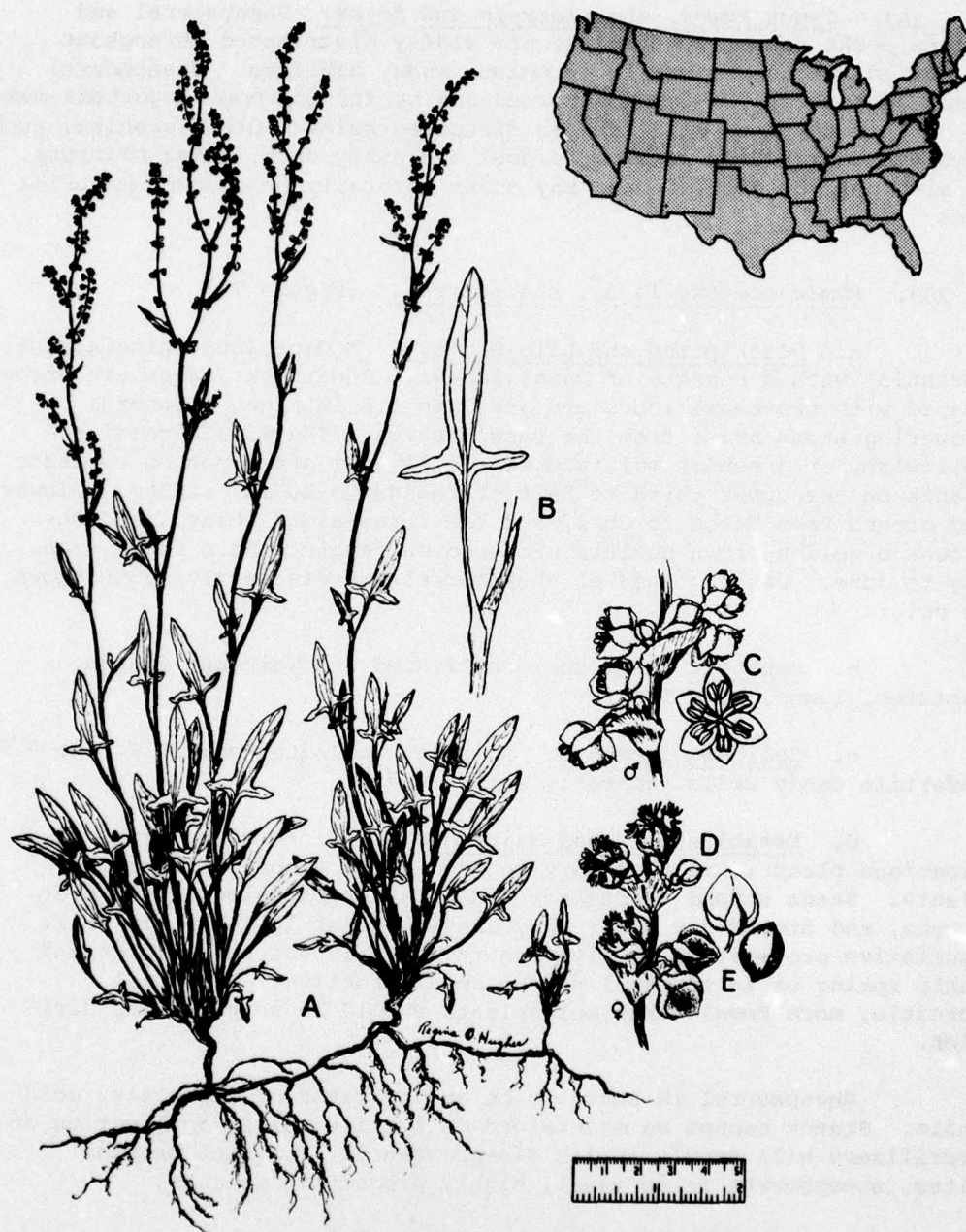


Figure 73. *Rumex acetosella*, sheepsorrel. A, habit x 0.5; B, leaf detail x 1.5; C, staminate flowers x 7.5; D, pistillate flowers x 7.5; E, achenes, in and out of calyx x 10.

game birds, such as the blue grouse, ruffed grouse, ring-necked pheasant, bobwhite, and woodcock feed on the leaves or seeds. Small mammals (mice, rats, ground squirrels) eat the seeds and leaves, and mule deer and cottontail rabbits consume the plants (Martin et al. 1951). The low rosettes provide no appreciable wildlife cover.

g. Comments. Sheepsorrel is easily confused with heart sorrel (*Rumex hastalulus*) which is extremely abundant in sandy, coastal plain fields in the Southeast. The two are similar in general appearance, but the fruits are distinctive. The surrounding nutlet of the heart sorrel (enlarged, winged calyx) is not present on nutlets of sheepsorrel.

264. Genus *Sesbania*, *sesbania*. Approximately four herbaceous and shrubby species of *sesbania* occur in this country. They are most common along the Gulf coastal plain and the Mexican border. Hemp *sesbania* (*Sesbania exaltata*), discussed below, has the widest distribution.

265. *Sesbania exaltata* (Rafinesque) Rydberg, hemp *sesbania*.
(Figure 74)

a. Description and Life History. A widely branching, herbaceous annual to 4 to 12 ft, appearing somewhat shrubby. The compound leaves are 4 to 12 in. long, made up of 20 to 70 narrowly oblong to linear, 0.4- to 1.2-in.-long leaflets. The yellow, 0.6-in., pealike flowers may be spotted with purple. Clusters of four to seven flowers arise from leaf axils and bloom from July to September. The slender, compressed legume is 4 to 8 in. long and 0.12 to 0.19 in. wide and contains 30 to 40 seeds which ripen from August to November.

Hemp *sesbania* is a vigorous grower.

b. Habitat. Full sun; ditches, fields, waste places.

c. Soil Requirements. Moist to well-drained; pH 5.0 to 7.0; rich sandy soils, sandy loams, silts, alluvial soils.

d. Establishment and Maintenance. Seeds should be collected in the fall when ripe, removed from the dried pods, and either sown immediately or in early spring. Hemp *sesbania* requires a long growing season. Seeds may be broadcast or planted in rows on moist rich soils. Plantings should be amply fertilized. Mixed plantings made in early spring with equal amounts of brown-top millet (*Panicum texanum*), proso millet (*Panicum miliaceum*), and Florida beggarweed (*Desmodium tortuosum*) have proved successful. Weed competition can be controlled by one cultivation while plants are becoming established (Graham 1941). Hemp *sesbania* plants will provide quick support for annual and perennial vines.

e. Disease and Insect Pests. Root knot due to soil nematodes can be a problem on infertile soils. However, if grown on previously uncultivated soils, nematodes should not be a problem.

f. Wildlife Value. Low food value; medium cover value. The seeds are probably of most value to the bobwhite (Davison 1967, Stoddard 1931), but they have also been recorded in stomach records for the mallard, limpkin, pintail, Gambel quail, and mourning dove (Graham 1941). The seeds are available throughout the winter and into the spring and are probably used by a greater diversity of wildlife than is documented. Hemp *sesbania* provides limited cover, but the open areas

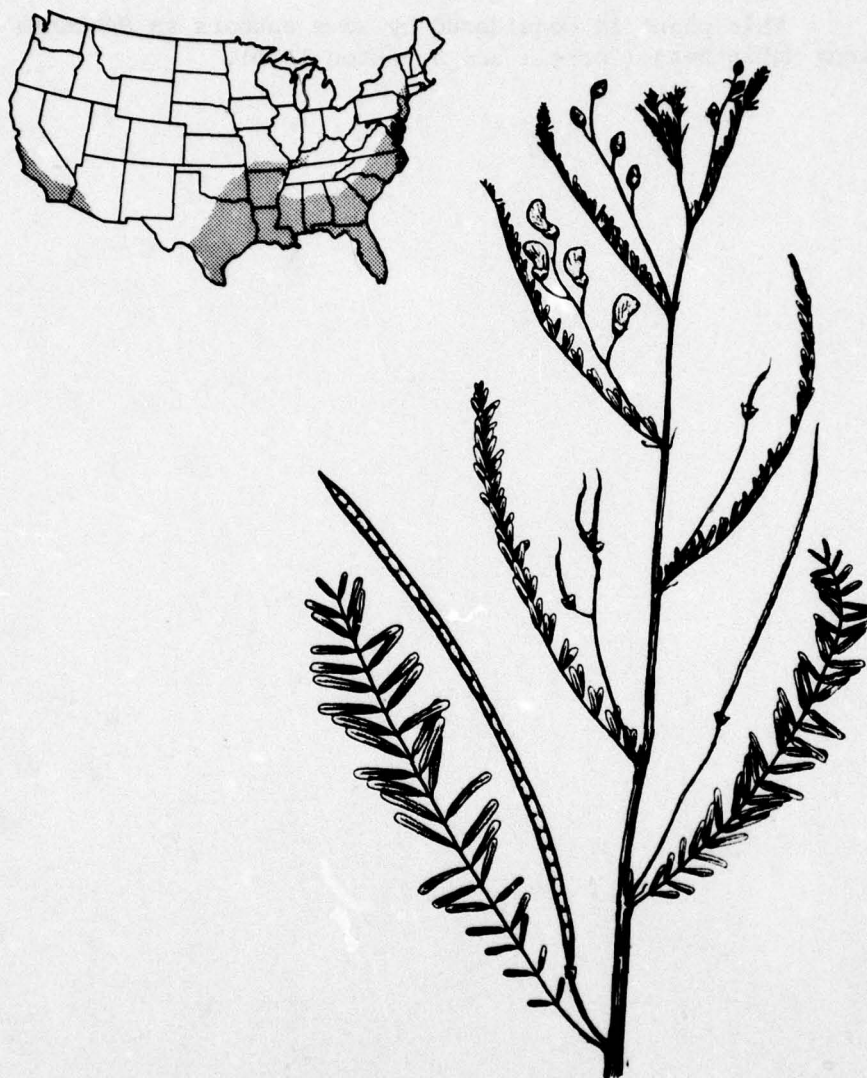


Figure 74. *Sesbania exaltata*, hemp sesbania. Habit x 0.5.

beneath stands of hemp sesbania allow low-growing herbs and vines with supplementary wildlife value to become established.

g. Comments. Hemp sesbania is sometimes grown as a green manure and a cover crop in the Southeast.

This plant is considered by some authors as *Sesbania macrocarpa* Muhlenberg (Correll and Johnston 1970).

266. Genus *Strophostyles*, wild bean. Three species of these annual or perennial trailing and climbing herbaceous vines occur primarily in the eastern U. S.; they are most common in the Southeast. In addition to trailing wild bean (*Strophostyles helvola*) described below, there are two other important species. Little flower wildbean (*Strophostyles leiosperma*) reaches westward to New Mexico. Perennial wild bean (*Strophostyles umbellata*) is the only perennial, and its range is similar to that of trailing wild bean. In the South, all of these species reseed themselves.

267. *Strophostyles helvola* L., trailing wild bean. (Figure 75)

a. Description and Life History. A viny, summer annual legume which grows flat as a ground cover or scrambles over other herbaceous growth and low shrubs by means of twining stems. These stems, sometimes to 9 ft or more, are smooth to somewhat hairy. Leaves are trifoliate; the leaflets are ovate-oblong and usually slightly lobed. Clusters of few to several flowers appear in middle to late summer on stalks 2 to 6 in. long. Flowers are rose to lavender in color, often turning green. The dark-brown to almost black bean pods, which ripen in the fall, are 2 to 4 in. long and covered with fine soft hair. Seeds with a light-brown felty outer coat are about 0.4 in. long. They remain in the pods for some time before shattering. The felty cover and dark seed coat beneath resist moisture penetration. As a result, seeds remain intact over winter to volunteer the following spring. The plant has medium to good salt spray resistance.

b. Habitat. Full sun; beaches, open woods, clearings.

c. Soil Requirements. Moist, well drained, dry; pH 5.0 to 8.0; beach dune sand to loam, silt, clay.

d. Establishment and Maintenance. Scarified seeds are planted in early spring at the rate of 25 lb per acre if broadcast or 12 lb per acre if seeded in 30-in. rows. Germination and early growth are slow. A protective grass cover may be sown at the same time if not already established prior to planting of trailing wild bean. A cover of annual or perennial grasses such as wheat, rye, oats, barley, American beachgrass, ryegrass, or tall fescue is recommended. The small grain crops offer additional value to the site since they will provide food for wildlife as well as cover for the young wild bean seedlings. If the protective cover method is used, the beans are planted in rows among a light broadcasting or between the rows of the protective grass cover.

Trailing wild bean seeds are not available from commercial sources. However, the plants' upright seed stems, prolific seed crop, and the shatter resistance of the pods should facilitate hand or machine harvesting.

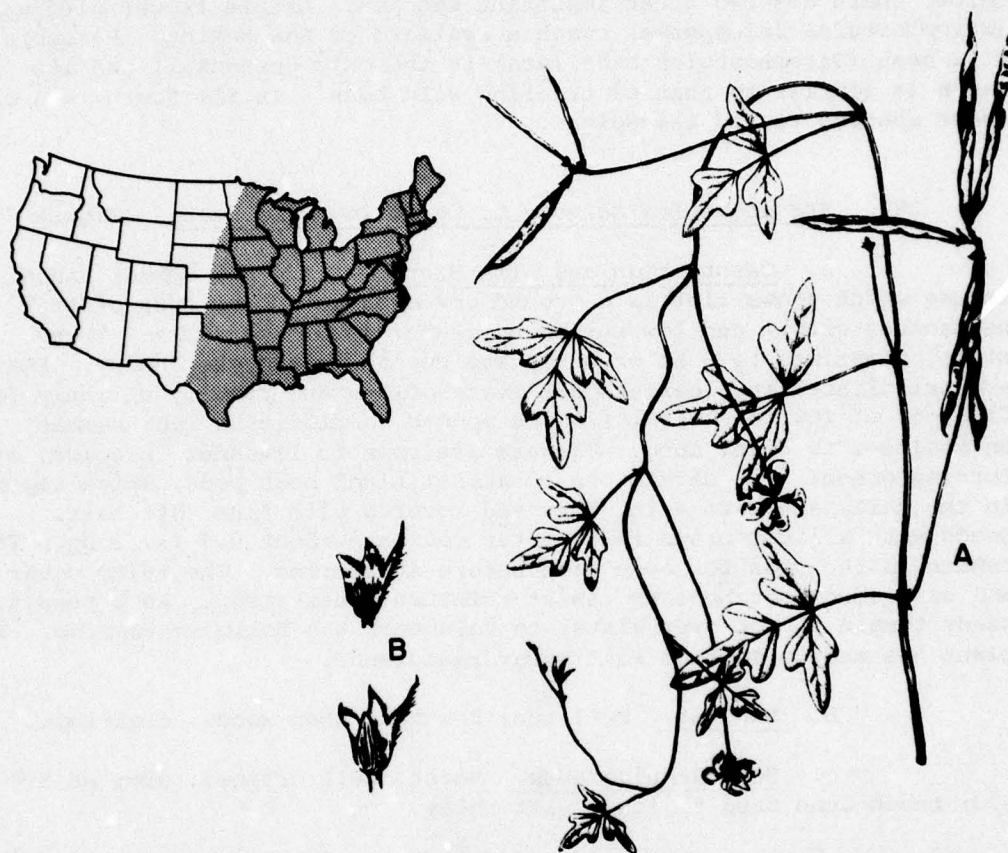


Figure 75. *Strophostyles helvola*, trailing wild bean. A, habit; B, calyx and bractlet.

To maintain, a light stirring of the soil may be needed. Heavy leaf drop and freezing and thawing of the soil most often provides sufficient covering.

e. Wildlife Value. Low to medium food value; medium cover value. Trailing wild bean is a fair food of the bobwhite and mourning dove (Davison 1967) and is eaten by the ring-necked pheasant (Graham 1941). Based on other known users of the genus (Graham 1941) and on unpublished observations, other users likely include the marsh rabbit, white-tailed deer, wild turkey, some waterfowl, and various small rodents.

This herbaceous vine frequently climbs over other herbaceous or shrubby vegetation, together forming excellent nesting, resting, feeding, or escape cover for ground-feeding or ground-nesting birds and small mammals.

f. Comments. On the North Carolina Outer Banks trailing wild bean volunteers dependably each year on the sand dunes. Seeds that are shed in the fall lie on the sand surface and are polished and scarified by wind-driven sand during the winter. In spring when the dune sands begin to warm, the seeds germinate. During early summer, growth is slow and volunteer seedlings are hardly noticeable in the dune grasses. But in August and September they grow rapidly, and soon large dense patches have completely enveloped other herbaceous growth.

268. Genus *Trifolium*, clovers. It is estimated that there are between 75 and 85 native, true clovers (members of the genus *Trifolium* only) in the country. Many more have been introduced from other countries for forage crops. The native species are particularly well represented in the Pacific and Mountain-Desert regions. Species of greatest importance to western wildlife are the native tomcat clover (*Trifolium tridentatum*), clammy clover (*Trifolium obtusiflorum*) and foothill clover (*Trifolium ciliolatum*). A useful species in the east is alsike clover (*Trifolium hybridum*) which adapts well to poorly drained acid soils. Alsike clover and the species selected for discussion, red clover (*Trifolium pratense*) and white clover (*Trifolium repens*), are all introduced species.

269. Records show that *Trifolium* species are used as food by more kinds of wildlife than any other leguminous genus (peas, beans, etc.) in the United States (Graham 1941).

270. In addition to being very significant wildlife foods, the clovers increase nitrogen levels in the soils on which they grow, and they are important soil binders.

271. *Trifolium pratense* L., red clover. (Figure 76)

a. Description and Life History. A biennial to short-lived perennial with ascending stems 16 to 24 in. long arising from a crown. The taproot is highly branched. Stems and branches are hollow and usually hairy. The compound leaves are typical clover leaves, each leaflet 0.4 to 1.2 in. long and 0.2 to 0.6 in. broad. Many small rose-pink flowers are born in spherical clusters or heads, 0.5 to 1.2 in. long; each head is subtended by a pair of leaves. The small, short, one-seeded legumes contain kidney-shaped seeds which vary in color from yellow to deep violet. Red clover flowers and fruits from April through September. There are two kinds of red clover, medium (double-cut) described above, and mammoth (single-cut) which is about a third larger and is later maturing. The medium form is used almost exclusively in the Northeast. Several varieties adapted to different parts of the country are available.

b. Habitat. Full sun; forage crop, pastures, fields, yards, waste places, soil improvement plantings.

c. Soil Requirements. Moist to well drained; pH 5.0 to 7.5; loams, silts, clays.

d. Establishment and Maintenance. A wide selection of *Trifolium* varieties are available from commercial sources. Seeds may be broadcast or drilled in pure stands, but they are often planted with mixtures of grains and grasses. Red clover seeds should be inoculated before planting in the spring or late summer. In the south fall



Figure 76. *Trifolium pratense*, red clover. A, habit; B, calyx showing withering petals.

plantings may be made several weeks before the first frost. Spring seedings over fall-planted grasses are also possible. Seeds should be planted 0.25 to 0.5 in. deep; a firm, weed-free seedbed is essential for establishing a dense stand. If seeds are broadcast, use 8 to 12 lb per acre, and if used in mixtures, 2 to 4 lb per acre. Fertilizers high in phosphorus and potassium are the most useful for encouraging dense growth. Red clover will have to be replanted to maintain permanent plantings; however, its greatest value may be in improving the soil for longer lived herbs and woody plants (USDA-SCS 1969-1976).

e. Disease and Insect Problems. None.

f. Wildlife Value. High food value; medium cover value. Information on wildlife use of red clover is limited; however, Martin et al. (1951) list 40 users of the genus *Trifolium*. The foliage is the primary part eaten, although some birds also feed on the seeds. The wild turkey, prairie chicken, ring-necked pheasant, and most grouse and quail species feed on the seeds and foliage; songbirds feed primarily on the seeds. The foliage and plants are eaten by the woodchuck, beaver, muskrat, porcupine, raccoon, snowshoe hare, and cottontail rabbit. Various mice and ground squirrels eat the foliage; mule deer and white-tailed deer consume the plants (Martin et al. 1951). Canada geese and the American wigeon are waterfowl which often feed on clover in upland sites (Bellrose 1976). The animals listed above would likely use red clover if available.

Red clover is a low ground cover which provides nesting and resting sites and concealment (from predators) for small mammals and ground-nesting or ground-feeding birds. The value of the cover depends on the density of the stand, whether in a pure stand or in conjunction with other herbaceous growth (such as fescue, with which it is often planted).

272. *Trifolium repens* L., white clover. (Figure 77)

a. Description and Life History. A long-lived, shallow-rooted perennial with creeping branches that frequently root at the nodes. The stems are generally 4 to 16 in. long. The three leaflets making up the compound, typical clover leaves are elliptic to obovate in shape. The leaflets have finely serrate margins and are 0.4 to 1.2 in. long. Small white flowers in nearly round heads, 0.4 to 1.2 in. diameter, are born from April to September on stalks 4 to 10 in. long which arise from the stems running along the ground. The oblong to linear legumes, 0.16 to 0.2 in. long, typically contain three to four very small seeds. Seeds ripen while the plant continues to flower.

Another form, ladino clover, is from two to four times as large as the common white clover. The stems of ladino are hollow, and the leaves are shiny on the underside. Numerous cultivars adapted to various regions of the country are available.

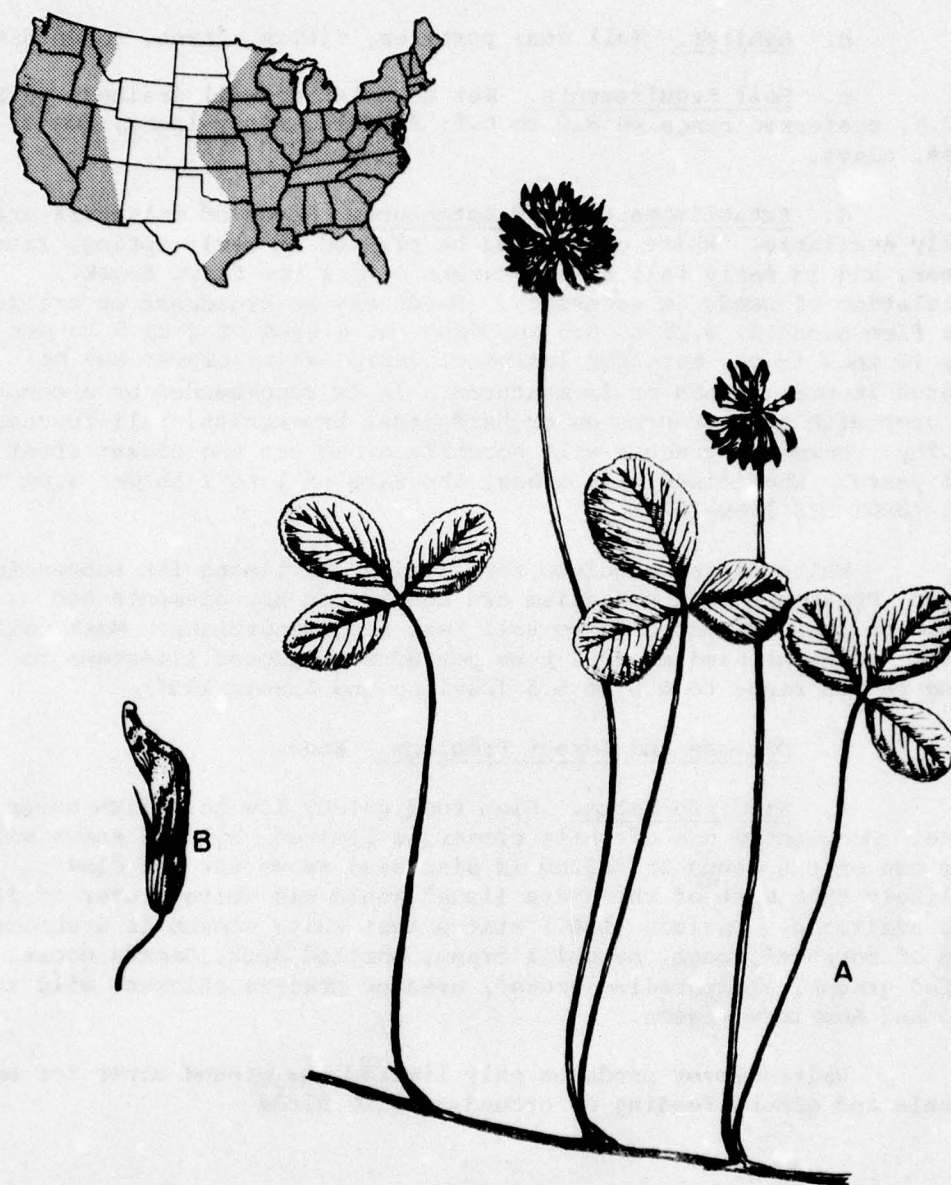


Figure 77. *Trifolium repens*, white clover. A, habit; B, flower x 3.

b. Habitat. Full sun; pastures, fields, lawns, roadsides.

c. Soil Requirements. Wet to moist to well drained; pH 5.0 to 7.5, preferred range pH 6.0 to 6.5; fertile, sandy loams, loams, silts, clays.

d. Establishment and Maintenance. Seeds of cultivars are widely available. White clover can be planted in early spring, late summer, and in early fall about 2 weeks before the first frost. Inoculation of seeds is necessary. Seeds may be broadcast or drilled on a firm seedbed, 0.25 to 0.5 in. deep, at a rate of 2 to 5 lb per acre (2 to 3 lb per acre for ladino clover). White clover may be planted in pure stands or in mixtures. It is recommended as a companion crop with such grasses as orchardgrass, brome grass, tall fescue, and timothy. However, grasses will normally crowd out the clover after 2 to 3 years. When mixed with grass, the rate of 1 to 2 lb per acre is used (USDA-SCS 1969-1976).

White clover requires fertilizing and liming for successful growth. Phosphorus and potassium are considered key elements and should be applied according to soil test recommendations. Most soils in the Southeast need about 2 tons per acre of ground limestone to bring the pH range to 6.0 to 6.5 (Davison and Graetz 1957).

e. Disease and Insect Problems. None.

f. Wildlife Value. High food value; low to medium cover value. Documented use of white clover is limited, but the known wildlife use of the genus *Trifolium* is discussed above for red clover. It is likely that most of the users listed would use white clover if it were available. Davison (1967) states that white clover is a choice food of bobwhite, coot, sandhill crane, mottled duck, Canada goose, ruffed grouse, sharp-tailed grouse, greater prairie chicken, wild turkey, and American wigeon.

White clover produces only limited low ground cover for small mammals and ground-feeding or ground-nesting birds.

Grasses

273. Genus *Ammophila*, beachgrass. Two species of *Ammophila* grow in the United States. European beachgrass (*Ammophila arenaria*) was introduced near San Francisco and has become established northward along the Pacific coast. This species has also spread sparingly from plantings in Massachusetts. The native American beachgrass (*Ammophila breviligulata*) occurs from Newfoundland southward to North Carolina and westward around the Great Lakes. Both species are excellent plants to use on coastal dunes because they form a coarse and hardy clump that can survive most of the stresses of coastal dune environments. Although their wildlife value is rather low, these plants may be useful for cover establishment on some dredged material sites.

274. *Ammophila arenaria* Link, European beachgrass. (Figure 78)

a. Description and Life History. A perennial, cool season grass with erect, rigid, smooth stems 2 to 3.5 ft in height. The leaves are narrow, seldom more than a foot in length, chalky blue above and rough on the underside. Plants grow in clumps sometimes exceeding 100 stems, which have numerous broad overlapping sheaths at the base. The plant spreads from deep, strong extensively creeping rhizomes. Seeds are borne in chaffy spikes at culm tips. They are 6 to 12 in. long and nearly cylindrical in cross section. Most growth takes place in late winter to late spring and in the fall. Salt wind resistance is good.

b. Habitat. Full sun; sand dunes along northern Pacific coast.

c. Soil Requirements. Well drained to dry; pH 5.8 to 7.5; sands, sandy soils.

d. Establishment and Maintenance. See establishment and maintenance section under American beachgrass (*Ammophila breviligulata*) below.

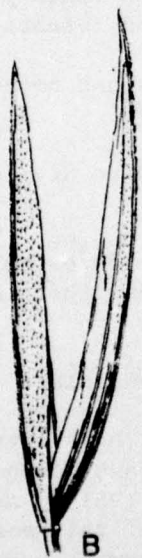
e. Disease and Insect Problems. Negligible.

f. Wildlife Value. Low food value; high cover value. There is essentially no documentation of this grass being eaten by wildlife but greater use is probable (Martin et al. 1951). As with the American beachgrass, the cover characteristics of this west coast species would be high for the birds and small mammals occurring in its habitat.

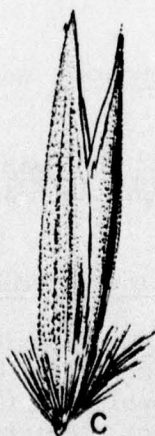
g. Comments. A special strain of European beachgrass was selected by the SCS Plant Material Center in Cape May, New Jersey. The number of this selection is NJ-965. It is better adapted to the north-



A



B



C



D

Figure 78. *Ammophila arenaria*, European beachgrass. A, habit; B, glumes x 5; C, floret x 5; D, ligule x 5.

east coastal dunes than the common strain. A block of it is kept on hand as a possible substitute for American beachgrass which has begun to experience disease problems. European beachgrass is best suited to dunes along the coast of Washington and Oregon (USDA-SCS 1969-1976).

It is one of the very few grasses which will furnish relatively fast cover on the most critical, almost pure sand sites where there is excessive sand movement. It is also ideal as a protective planting for later plantings of more permanent species.

275. *Ammophila breviligulata* Fernald, American beachgrass.
(Figure 79)

a. Description and Life History. Perennial cool season grass with stiff erect stems to 3.5 ft tall. Mostly evergreen in the winter. Growth is in clumps with as many as 100 coarse stems, each with numerous dry sheaths around the base. Stems and nodes are smooth. Leaves are shorter than the stems and rolled inward toward the rough upper surface. The plant spreads from an extensive rhizome system. Spikes of seeds mature on the tips of stems. They are 6 to 12 in. long, pale yellow, almost cylindrical in cross section, and chaffy. The grass is extremely salt spray resistant.

b. Habitat. Full sun; seacoast dunes along the northern Atlantic coast and dunes in the Great Lakes area.

c. Soil Requirements. Moderately well drained to dry; pH 5.8 to 8.0; fine to coarse dune sand.

d. Establishment and Maintenance. While this species does produce some viable seeds, it is propagated vegetatively by planting the stems. The tufts of stems are easily lifted with a spade and then divided into single plants. Each stem makes a planting providing it has one or more latent buds at the base. Usually one stem is used in each planting hole. An average planting rate is one plant per 4 sq ft (2-ft middles with plants 2 ft apart in the row); if the site is very exposed with much sand movement the rate can be increased to 2 sq ft per plant. Conversely, on less stressed sites the rate can be reduced to 6 or even 8 sq ft per plant.

Transplanting should take place during the dormant season and preferably when the mean temperature is 55°F or less. Tree planters, tobacco planters, and other planters can be easily modified to handle large accessible planting jobs. On small plantings, it is easy to plant by hand using various opening tools such as long narrow spades. A wood-splitting wedge welded to a length of pipe makes a good opener (Graetz 1973). Depth of planting is 6 to 8 in. Each plant must be firmed with the heel. A rounded teaspoon of 8-8-8 in the heel

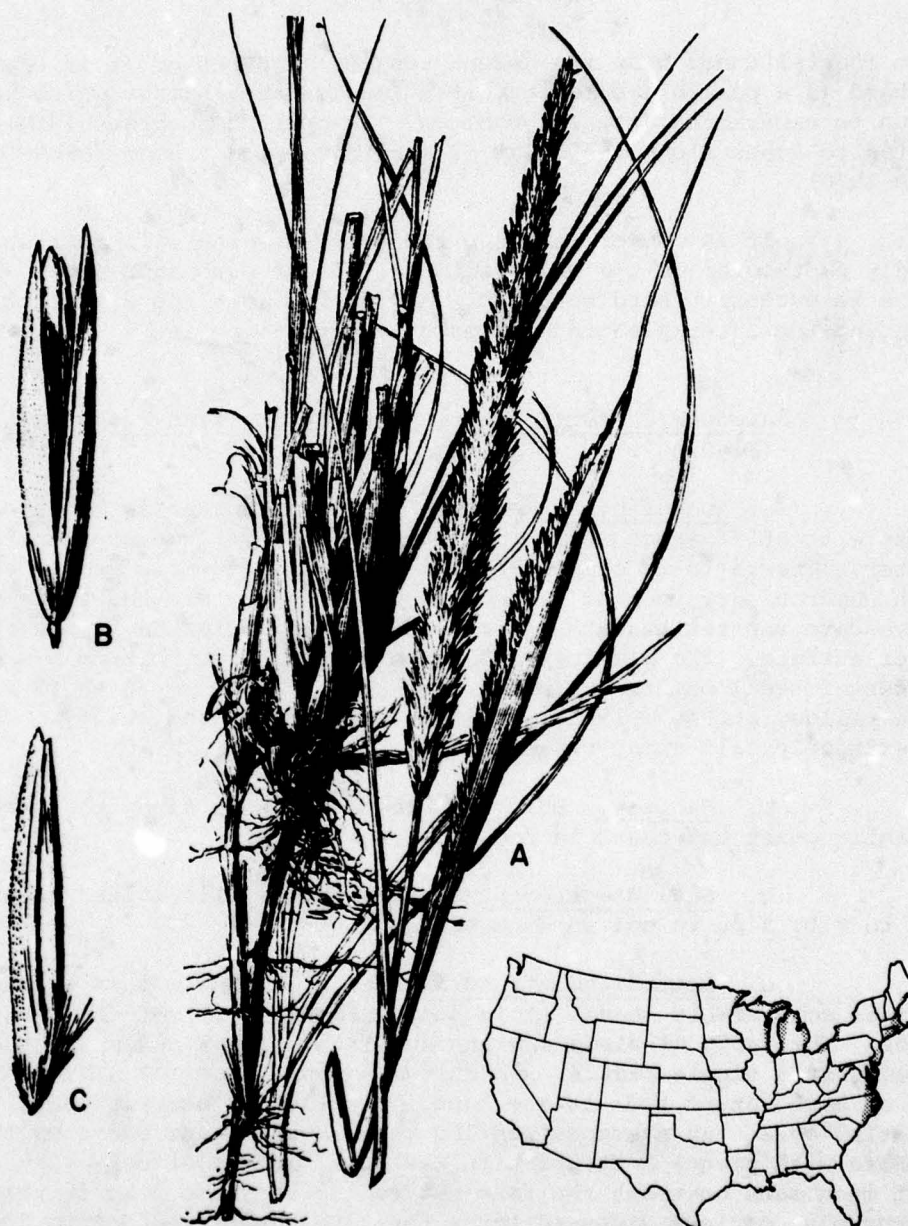


Figure 79. *Ammophila breviligulata*, American beachgrass. A, habit x 0.5; B, spikelet x 5; C, floret x 5.

mark will help in establishment. The plants must be kept wet (in buckets) before planting.

Response is quick if a fertilizer high in nitrogen is applied just before the cool growing seasons. After the sand is stabilized, beachgrass tends to thin out if not fertilized. Use of fertilizer should be regarded as the first step in a series of plantings.

e. Disease and Insect Problems. A destructive scale insect *Eriococcus carolinae* has infested American beachgrass in some places along the eastern seacoast. Most of the damage has taken place in states north of North Carolina. The scale is effectively controlled by spraying Cygon 267 at the rate of 1 lb per acre (Campbell 1972). A fungus disease called Marasmius blight is causing some trouble. Areas behind the frontal dunes where stands become dense and lodged are most vulnerable. Where it attacks, the grass is killed out in circular patches. So far spraying has not been practical.

f. Wildlife Value. Low food value; high cover value. There is very little documented use of American beachgrass as food for wildlife. The main known use of the seeds is by the snow bunting and Ipswich sparrow (Martin et al. 1951). Larger numbers of land birds (blackbirds, sparrows, and other fruit- and seed-eaters) do feed on the fruiting heads before the seeds ripen, and insectivorous birds feed amidst the foliage.

The dense growth form of beachgrass provides excellent cover for the kinds of wildlife occurring on the front dunes where this plant grows naturally and is often planted. Beachgrass also grows on the tops and slopes of dredged material and provides good cover for a still larger number of wildlife species.

g. Comments. A natural occurrence of this species ranges down along the North Carolina coast almost to the South Carolina line. Since plants develop very few to almost no seed heads south of Cape Lookout on the Outer Banks, the presence of this grass was largely overlooked in this southward extension of its range until the late 1960's. SCS plantings in 1970 near Charleston and Georgetown, South Carolina, have been successful (Graetz 1973).

At present three selections are available commercially: "Lewes" an early common collection, "Cape" a robust SCS selection, and "Hatteras" a fine and numerous-stemmed type developed by N. C. State University.

Because it grows in clumps and tends to fade out after sand has been stilled, American beachgrass is regarded as an ideal protective cover plant.

276. Genus Avena, oats. The genus *Avena*, wild and cultivated oats, is an Old World assemblage of approximately 70 species that are better adapted to a wide range of soil types, cultivation techniques, and climatic extremes than are most other cereals. The commonly cultivated species, *Avena sativa*, is not known from the wild and had been domesticated by 2500 B.C. in northern Africa. The oat grain is fairly rich in protein (14 percent) and fat (4.3 percent); the remainder is carbohydrate and crude fiber. Oats are valued not only as a seed crop but also as a forage and cover plant. The usefulness of this genus is underscored by a long planting season (fall and early spring) and rapid maturity of the plants, enabling one to grow other crops after oats mature and are harvested.

277. *Avena sativa* L., oats. (Figure 80)

a. Description and Life History. A cultivated and agriculturally important, widespread cereal crop of temperate and cold climate regions. Oats are tufted annuals, often producing several fruiting stems which branch outward and upward forming a noticeable angle in the lower stems. The flowers are small, highly modified, and enclosed by specialized floral bracts. At first the bracts are pale green, later whitish with green nerves, and at maturity pale yellowish tan. The tapered spikelets have long, firm points and are suspended downward by a flexuous capillary branch. A robust plant may have 50 or more spikelets per stem and each spikelet has one or two grains. Cultivated strains of oats are classified as winter or spring varieties, depending upon the season of planting. The winter varieties must be planted after the threat of hot, dry autumn weather is past but before the onset of hard freezes; they are usually sown in September or October. The seedlings emerge after a week or 10 days, depending upon temperature and soil moisture, and rapidly develop into densely tufted plants. Little growth occurs during the winter, and severe weather may freeze less vigorous plants. In spring the dark-green leaves elongate; other leaves form but are surpassed by the flowering stems. Lodging (collapsing of stems) is a common problem, especially where soils are unusually fertile and the fruiting stalks heavy and tall.

b. Habitat. Full sun; cultivated, sporadically occurring on roadsides, barnyards, waste areas.

c. Soil Requirements. Moist; optimum pH 4.5 to 7.5; loams, clay-loams, silty loams.

d. Establishment and Maintenance. Oats require more moisture than either wheat or barley. The seeds are either drill planted or broadcast in a prepared seedbed. It is customary to plant oats after a legume crop because of the additional soil nitrogen provided by the latter (Leonard and Martin 1963). Application of high nitrogen fertilizers will yield taller stalks and thus increase the likelihood



Figure 80. *Avena sativa*, oats. A, habit; B, seed head; C, open spikelet with glumes x 2.

of lodging--a problem to farmers but a desirable result on sites being developed for wildlife habitat. For the northern part of the United States, light applications of nitrogen fertilizer are recommended during cold, wet springs until the soil warms enough to allow nitrification. The fertilizer required for a specific area depends largely on local growing conditions and soil chemistry. Rate of application is generally 250 to 500 lb per acre drilled into the soil at the time of seeding. If seeding by grain drill, approximately 2.5 bushels of seed per acre is needed for humid regions; half this amount is needed for dryland conditions. If an oats sod is desired, however, about 3.5 bushels per acre should be planted. Winter oats can seldom be grown north of middle Missouri, and they should be planted 3 to 4 weeks prior to the first killing frost. Spring plantings can be seeded as early as the land can be prepared, usually not later than May 15. Cold weather enhances tillering and filling. Maximum yields are variable, but for prime agricultural land, 30 to 70 bushels per acre can be expected. Yields on dredged material will be considerably less.

e. Disease and Insect Problems. Oats are susceptible to several kinds of diseases, generally classified as smuts, rusts, blights, leaf blotches, and mosaic diseases. Loose smut is common in the south Atlantic states; covered smut occurs in the western states. The smuts can be controlled by volatile fungicides applied to the seeds. Crown rust is a common disease of the more humid oat-growing regions and may result in 20 to 50 percent mortality (Leonard and Martin 1963). This fungus attacks leaves, infects other grasses, and has an alternate host, buckthorn (*Rhamnus* spp.). Control measures include elimination of the buckthorns from the growing area and the planting of resistant strains of oats. The blights, leaf blotches, and mosaic diseases are caused by other fungi or viruses, for which no chemical control substances have been synthesized. Insect damage to oats is caused by stem borers, grain aphids, leafhoppers, grasshoppers, and others. It is estimated that insects are responsible for an average annual loss of 5 percent of oats in storage. Estimates for field damage are not available. Losses in the field due to disease or insect infestation are accentuated by pure stands of the crop. By planting oats with other wildlife food or cover crops, the potential for crop damage is greatly reduced.

f. Wildlife Value. High food value; low to medium cover value. Oats rank next below wheat and corn among the cultivated grain crops as a wildlife food. Martin et al. (1951) list 91 wildlife users and Davison (1967) lists 71 bird users that eat oats (principally the seeds). These animals are similar to those making extensive use of other cultivated grains such as wheat and corn. The cover value of oats will vary with the stage and condition of the stand, with the best condition being mature, unharvested plants. The primary use of oats would be as a wildlife food planting where intensive wildlife management efforts are possible and warranted.

278. Genus *Digitaria*, crabgrasses. A nemesis to gardeners, the crabgrasses are ubiquitous with one or more species being found in nearly all regions of the United States. These natives of warm temperate areas are particularly troublesome in cultivated fields and gardens where they are enhanced by the removal of other weedy competitors. The seed crop is usually produced throughout the summer, but it is most prolific after vegetable or crop cultivation is over. The leafless, wiry stems bearing fingerlike branches develop quickly and the seeds shatter readily, falling to the soil where they overwinter and sprout the following spring.

279. *Digitaria ischaemum* (Schreber) Schreber ex Muhlenberg,
smooth crabgrass. (Figure 81)

a. Description and Life History. Native of Eurasia and now established across the United States, smooth crabgrass is a decumbent summer annual. The vegetative stems creep extensively from the wiry fibrous-rooted center crown, abruptly angling upward as they become reproductive. Flowering may persist from June until frost. The spikelets are purplish or purplish green, somewhat overlapping on linear branches of the inflorescence which diverge at near right angles from the main stem. An inflorescence may bear two to six of these frequently paired branches. The grains are ovate-lanceolate, ripening soon after the flowers are self-pollinated.

b. Habitat. Full sun to partial shade; fields, gardens, lawns, roadsides.

c. Soil Requirements. Moist to slightly dry; pH 4.8 to 8.0; loams or clays.

d. Establishment and Maintenance. To harvest the seeds, plants should be mowed and collected before completely dry, otherwise the seeds will shatter. When thoroughly dry, the seeds can be removed by hand or mechanical threshing. Seeds should be broadcast on disked, smoothed soil and then rolled lightly. Germination will occur within a few days if soil is moist and warm. This species is considered less of a pest species than the large crabgrass.

e. Disease and Insect Problems. Probably the same as for large crabgrass discussed below.

f. Wildlife Value. Low to medium food and cover value. Smooth crabgrass is used in much the same way by the same types and species of birds and mammals as is the large crabgrass (listed below). These two species of crabgrass grow and are used together in the same fields, waste places, and disturbed areas. The smooth crabgrass is a lower and less abundant plant, however, which accounts for its lower rating.

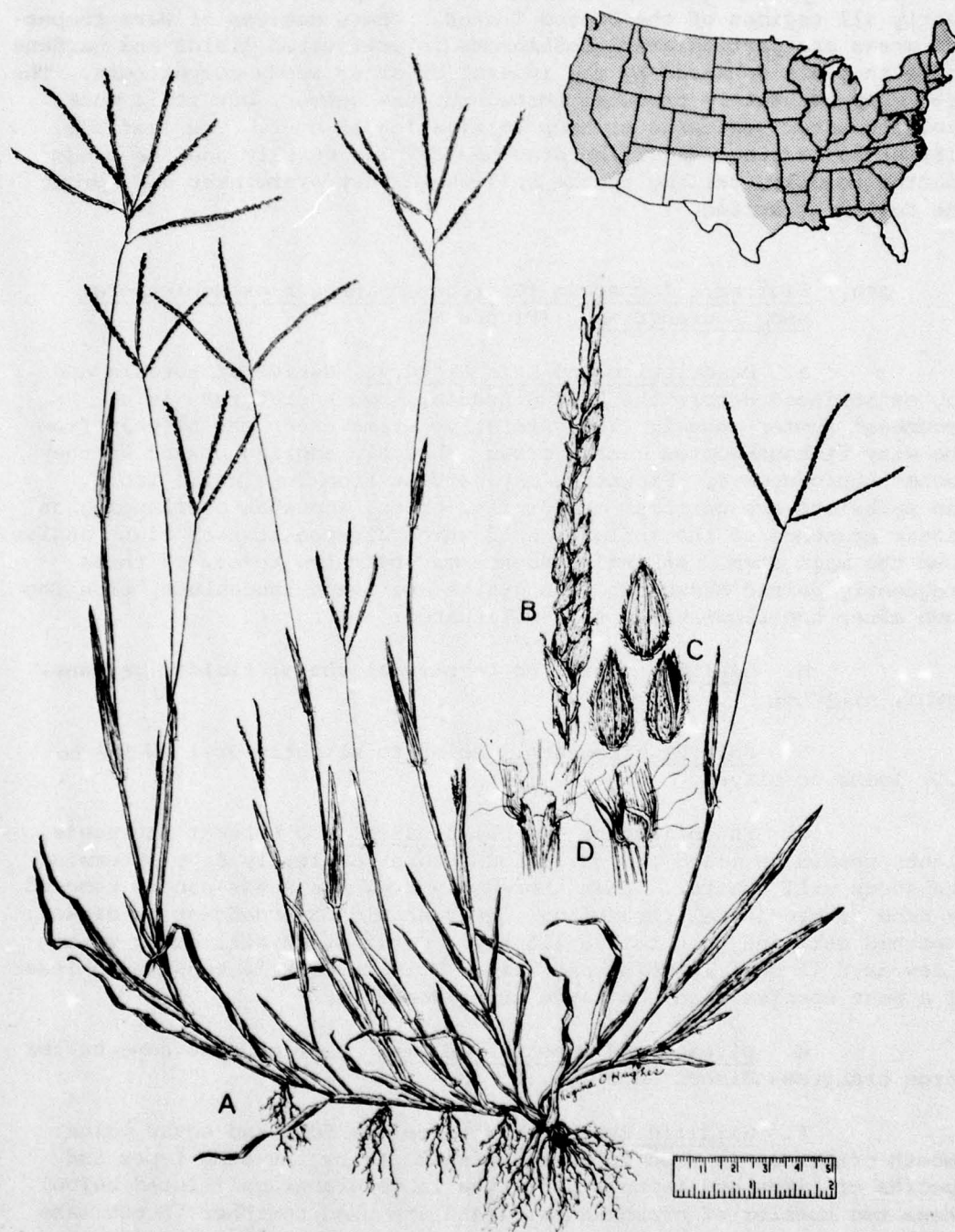


Figure 81. *Digitaria ischaemum*, smooth crabgrass. A, habit x 0.5; B, spike x 5; C, florets x 7.5; D, ligules x 5.

280. *Digitaria sanguinalis* (L.) Scopoli, large crabgrass.
(Figure 82)

a. Description and Life History. A prostrate mat-forming summer annual which roots at the nodes. Leaves and leaf sheaths are hairy. The plants flower and fruit from July to frost. The stems are erect and bear 3 to 10 linear branches with closely alternating spikelets. The inflorescence is green. The grain is elliptic and slightly longer than that of smooth crabgrass. In colder regions seeds usually germinate in the early spring after over-wintering. In warm regions they germinate throughout the year. Cold treatment may be necessary to induce germination. The plants are at first rather delicate with very short leaves, but the delicate appearance belies their gregariousness. Growth is rapid and in cultivated fields the juvenile plants almost appear overnight, particularly after a spring or summer rain.

b. Habitat. Full sun for best growth, but tolerant of partial shade; fields, gardens, roadsides, lawns, waste places.

c. Soil Requirements. Similar to those of smooth crabgrass.

d. Establishment and Maintenance. According to Holm et al. (1977), a single plant can produce 700 tillers and 150,000 seeds. In warm areas the plants flower all year long, provided adequate moisture is available. When the tops are cut or grazed the plant can produce three large seed crops in 6 months and therefore seeds can be collected over several months of the growing season. Because the seeds tend to shatter easily, appropriate care should be taken if the grass is mowed that over-drying does not occur; otherwise all of the seeds will be lost in the field. The plants, while still green, could be bound in shocks and the seeds threshed by hand over canvas or other suitable surface. Seeds might also be obtained in waste millings from local seed-cleaning establishments. In view of serious pest reputation that large crabgrass has acquired, commercial sources for seeds of this species may not be available. The short dormancy period can be prolonged by dry storage. Germination is best under warm moist conditions, and large crabgrass often thrives when other plants, including its competitors, are under severe heat and moisture stress. When seeds are broadcast on disked or slightly broken soil during warm weather, a scattering of survivors will quickly fill open spaces in the ground cover--single plants often form mats 10 ft or more in diameter. Once established, it is doubtful that large crabgrass can ever be completely eliminated from the site by natural processes alone. It is immune to triazine herbicides (Holm et al. 1977).

e. Disease and Insect Problems. Large crabgrass is an alternate host of several fungal diseases of other grasses. It is susceptible to nematodes and is eaten by grasshoppers and other field insects.

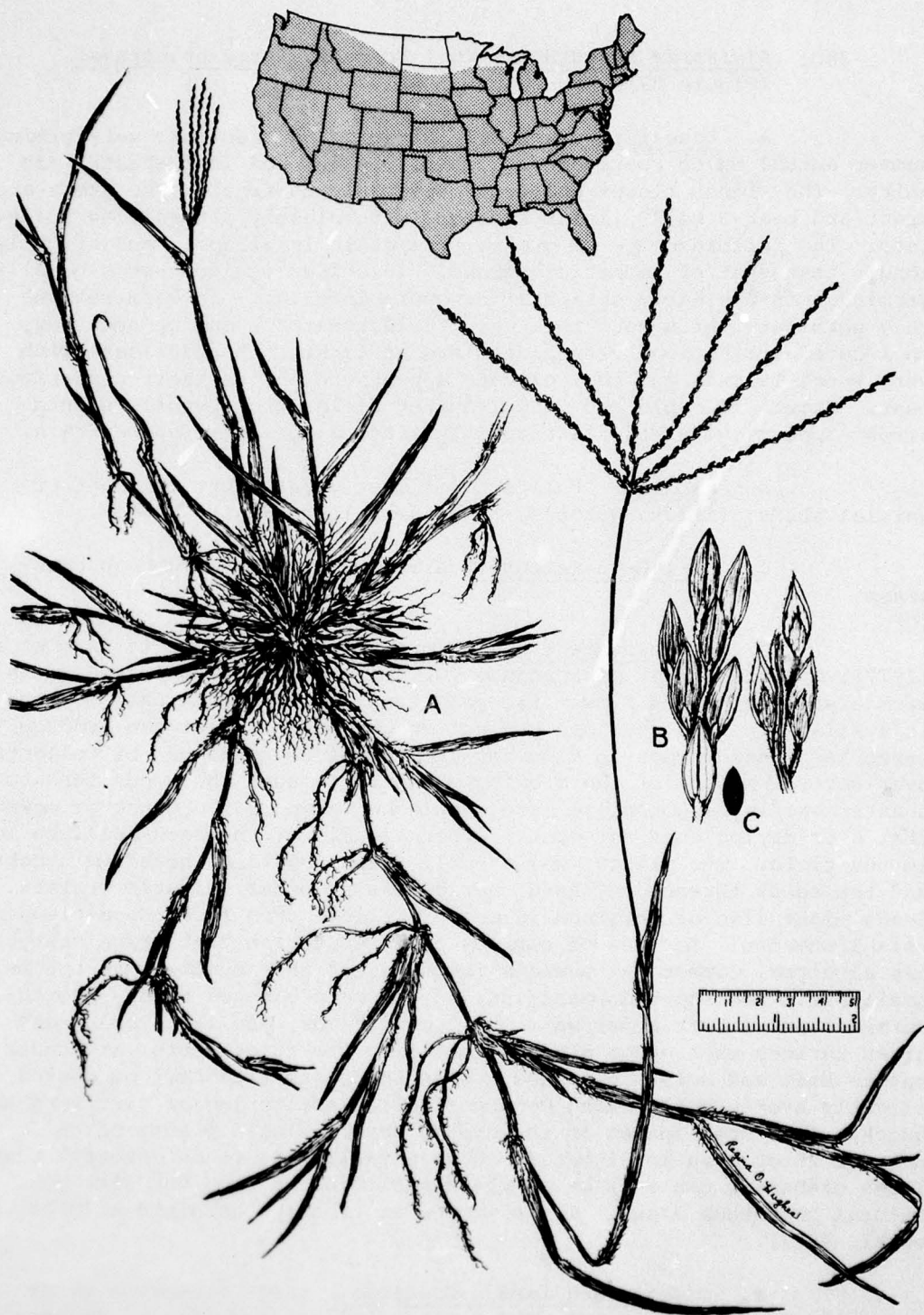


Figure 82. *Digitaria sanguinalis*, large crabgrass. A, habit x 0.5; B, two views of florets x 5; C, seed x 6.

f. Wildlife Value. Medium food and cover value. Crabgrass seeds are eaten extensively by a number of ground-feeding upland game birds (ground dove, mourning dove, bobwhite, and wild turkey), and sparrows, finches, and cowbirds; cottontail rabbits feed on the plants (Quay 1947, Martin et al. 1951, Cummings and Quay 1953). The small seeds fall from the plants to the usually bare ground below from late summer to late winter. Davison (1967) lists crabgrass seeds as a choice food of the indigo bunting, junco, Lapland longspur, water pipit, chipping sparrow, field sparrow, house sparrow, song sparrow, white-throated sparrow, Bachman's sparrow, savannah sparrow, swamp sparrow, and tree sparrow and a fair food of the mourning dove, ground dove, wild turkey, blue grosbeak, blackbirds, and "other small, seed-eating birds."

Crabgrass is good cover for the smaller, ground-feeding birds and mammals, both in pure stands and when in association with other herbaceous species of the old field plant succession stages, such as ragweed, horseweed, asters, goldenrod, and broomsedge.

281. Genus *Echinochloa*, wild millets. The grasses belonging to the genus *Echinochloa* are mostly annuals with compressed leaf sheathes, long leaves, and a stout, terminal, conical seed head. The native U. S. species are usually found in marshes, wet ditches, and margins of ponds. The moderately large seeds are especially used by ducks and other birds. In addition to the species discussed below, junglerice (*Echinochloa colonum*) is abundant in the Gulf region, growing on river shores, sandbars, and riverine dredged material.

282. *Echinochloa crusgalli* (L.) Beauvois, barnyard grass.
(Figure 83)

a. Description and Life History. A coarse annual to about 6 ft, found mostly in low, moist places. Blades are about 1.3 ft long, an inch or more wide on robust plants, and rough to smooth. The flowers and fruits are borne in a terminal inflorescence that is roughly lanceolate but that consists of alternating headlike clusters; the individual flowers are subtended by bracts with attenuated hairlike appendages (awns) which give the seed head a bristly appearance. The fruit is surrounded by short-bristled bracts; seeds are ovate. The plants begin growing in early spring; when young they are difficult to differentiate from other grasses. By early summer the stems, which later bear flowers and fruits, become distinct from the leaves of the plant. The plants flower and fruit from June until frost, or about 60 days after planting. When seed heads are mature the plants arch, making them especially noticeable along roadsides where they protrude from the other vegetation.

b. Habitat. Full sun to partial shade; moist to wet areas such as ditches, marshes, meadows; usually with other tall species, rarely found alone.

c. Soil Requirements. Moist or wet; pH 4.6 to 7.4; humus-rich sands, peat, sandy loam.

d. Establishment and Maintenance. Barnyard grass grows best in wet habitats but can be successfully grown on moist loam or sandy loams. Broadcast seeds at a rate of 10 to 20 lb per acre. According to Holm et al. (1977) the optimum temperature for germination is 90° to 99°F. Because germination of seeds near the surface is best on hot days, the seeds should be shallowly covered and the plantings performed in late spring. The seeds germinate best on wet soils. Optimum temperatures for seedling growth are near 86°F. Germination can be increased if the soil is compact rather than loose. The first tillers form about 10 days after emergence of the seedling, and normal plants produce about 15 tillers each. Recent research has shown that plants 2 ft apart produce five times the dry weight, inflorescences, and tillers as plants which are closely spaced (3 in.) (Holm et al. 1977). Barnyard grass removes most of the nitrogen from the soil and therefore



Figure 83. *Echinochloa crusgalli*, barnyard grass. A, habit x 0.5; B, spikelets x 10; C, floret x 10.

should be grown in conjunction with leguminous crops or fertilized heavily with nitrogen.

e. Disease and Insect Problems. Approximately a dozen fungal or viral diseases infect barnyard grass.

f. Wildlife Value. High food value; medium cover value. Barnyard grass occurs throughout the United States in a variety of habitats and is used extensively by a wide range of waterfowl, marsh birds, shorebirds, upland game birds, and songbirds, and by the muskrat and cottontail rabbit (Martin and Uhler 1951, Martin et al. 1951). Davison (1967) lists barnyard grass as a choice food of the red-winged blackbird, bobolink, cardinal, brown-headed cowbird, mourning dove, gadwall, Canada goose, white-fronted goose, slate-colored junco, mallard, eastern meadowlark, pintail, field sparrow, song sparrow, white-throated sparrow, blue-winged teal, and green-winged teal and a fair food of the Brewer's blackbird, canvasback, black duck, fulvous tree duck, mottled duck, ring-necked duck, wood duck, Smith's longspur, redhead, lesser scaup, shoveler, sora, house sparrow, Lincoln's sparrow, savannah sparrow, and American wigeon.

The tall and frequently dense stands of barnyard grass provide excellent protective, feeding, resting, and roosting cover for many birds and mammals.

g. Comments. Nitrates may accumulate in the plants to levels sufficient to be toxic if eaten by farm animals (Holm et al. 1977).

283. *Echinochloa crusgalli* var. *frumentacea* (Roxburg) W. F. Wight, Japanese millet. (Figure 84)

a. Description and Life History. Japanese millet is a cultivated variety of barnyard grass that is a heavy seed bearer and differs from the wild form by the dense purplish-brown inflorescence and slightly larger seeds. Cultivars are usually more robust than barnyard grass and often attain a uniform height of 3 to 4 ft. It is best adapted to temperate climates and under ideal growth conditions can produce a crop of grain 6 to 7 weeks after seeding (Leonard and Martin 1963). Japanese millet has a greater tolerance to salty soil than any other cereal. It is also resistant to wind damage.

b. Habitat. Full sun; an infrequent escape from cultivation to waste places, roadsides, fields.

c. Soil Requirements. Wet to moist; pH 4.6 to 7.4; humus-rich sands, peat, sandy loam, sandy clay.

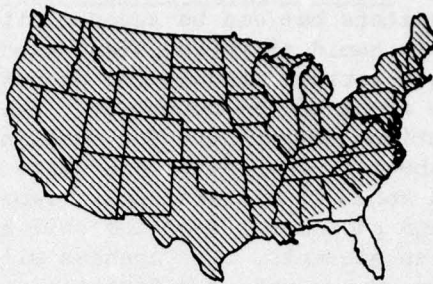


Figure 84. *Echinochloa crusgalli* var. *frumentacea*, Japanese millet.
Habit.

d. Establishment and Maintenance. Japanese millet grows best in wet habitats but can be successfully grown on moist loam or sandy loams. In humid climates, plant seeds at a rate of 20 to 25 lb per acre in late spring. Reduce the planting rate to 10 to 15 lb in the Midwest or dry areas of the Southwest. The seeds germinate best on warm wet soils. Optimum temperature for seedling growth is 86° F. The first tillers form about 10 days after emergence of the seedling, and normal plants produce about 15 tillers each. Japanese millet removes most of the nitrogen and phosphorus from the soil and therefore should be fertilized with these elements. If Japanese millet is grown in conjunction with leguminous crops, nitrogen fertilizer may be omitted. In general, the recommended rate of fertilizer application is 300 to 400 lb per acre of standard agricultural fertilizer of a 1-2-1 ratio (USDA-SCS 1969-1976). The plants also generally respond to application of 60 to 100 lb per acre of superphosphate.

e. Disease and Insect Problems. Japanese millet may become infested with smuts, but no diseases of major importance attacking this crop have been recorded.

f. Wildlife Value. High food value; medium cover value. Japanese millet is a cultivated variety of barnyard grass that is used by wildlife, especially birds, in much the same way and to the same extent as the regular barnyard grass (Martin and Uhler 1951, Martin et al. 1951). The seeds are a choice food of the bobolink, bobwhite, indigo bunting, cardinal, brown-headed cowbird, mourning dove, black duck, ring-necked duck, gadwall, blue grosbeak, slate-covered junco, mallard, pintail, field sparrow, house sparrow, song sparrow, white-throated sparrow, green-winged teal, and American wigeon and are a fair food of the wood duck (Davison 1967). Japanese millet is often used for waterfowl food plantings. It may be planted along pond banks or in marsh or pond areas which have been drained, planted, and are reflooded when the millet is ripe.

g. Comments. Some taxonomists consider Japanese millet to be a separate species. In this case the correct scientific name is *Echinochloa frumentacea* (Roxburgh) Link.

284. *Echinochloa walteri* (Pursh) Heller, Walter's millet.
(Figure 85)

a. Description and Life History. A dark-green annual with stems to more than 9 ft. Leaves are glabrous on both surfaces, but leaf sheaths, in contrast to other wild millets, have small wartlike protuberances and stiff hairs. The inflorescence is usually larger than barnyard grass and greenish; the individual branches may be 2 in. or more long. The fruit bristles or awns are much shorter than barnyard grass, being little more than 0.25 in. long. The grains are whitish, about 0.1 to 0.2 in. long, oblong to broadly ellipsoid. Flowering and fruiting occur from late June until frost.

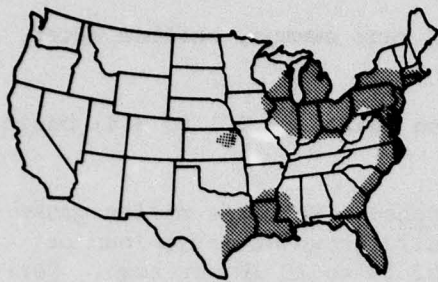


Figure 85. *Echinochloa walteri*, Walter's millet. A, habit; B, leaf base x 1; C, spikelet x 5.

b. Habitat. Partial to full sun; swamps, shallow water, marshes, low waste places.

c. Soil Requirements. Wet to moist; pH 5.1 to 9.4; basic to alkaline mucks and sands.

d. Establishment and Maintenance. Walter's millet grows best in wet habitats but can be successfully grown on moist loam or sandy loams. Broadcast seeds at a rate of 10 to 20 lb per acre. Germination of seeds is best on hot days. Therefore, the seeds should be shallowly covered and the plantings performed in late spring. Germination can be increased if the soil is firmed. The first tillers form about 10 days after emergence of the seedling, and normal plants each produce about a dozen tillers. Walter's millet probably should be grown in conjunction with leguminous crops or fertilized heavily with nitrogen.

e. Disease and Insect Problems. None.

f. Wildlife Value. Medium food and cover value. This taller smaller seeded, less widely occurring species of wild millet is of somewhat less important to wildlife than barnyard grass or Japanese millet. It is a choice food of the red-winged blackbird, fulvous tree duck, purple gallinule, white-fronted goose, mallard, and pintail and a fair food of cardinal, mottled duck, ring-necked duck, redhead, shoveler, blue-winged teal, and green-winged teal (Davison 1967).

285. Genus Festuca, fescue. The genus *Festuca* contains at least 33 native and introduced species in the United States. They are particularly abundant on well-drained slopes along the Pacific coast and in western mountain and desert regions. Some are perennials and others annuals; texture and growth habits vary greatly. The genus as a whole is versatile and has a wide variety of uses.

286. Annual species are considered to be weedy. The perennial ones have the highest value for forage grasses, particularly in the West. The seeds are also consumed by wildlife. In addition to the two perennial species selected for discussion, the annual, 6-weeks fescue (*Festuca octoflora*) is another possible choice for use on dredged material.

287. *Festuca arundinacea* Schreber, tall fescue. (Figure 86)

a. Description and Life History. A robust, bunched, evergreen, European grass. Stems are 3 to 4 ft tall, smooth and erect, and surmounted by a nodding seed panicle from 4 to 12 in. long. Roots are dense, fibrous, and occasionally with short rhizomes. Leaves are coarse, mostly basal, to 16 in. long and 0.25 to 0.64 in. wide, ridged on top, and generally smooth below. Seeds ripen in June. The grass is a cool season perennial species. Most growth occurs in the spring and fall. During the hot summer growth is restricted. "Kentucky-31" and "Alata" are well-known varieties.

b. Habitat. Full sun to shade; cultivated plant in hay and pasture fields, erosion control plantings on eroding sites, roadsides, lawns, athletic fields.

c. Soil Requirements. Moderately wet to well drained; pH 5.5 to 8.0; fine sandy soils to loam, silt, clay. Prefers rich, moist, fine-textured soils. Summer droughtiness of soils is a limiting factor.

d. Establishment and Maintenance. Seeds are commercially available. For cover and wildlife use, tall fescue is broadcast at a rate of 20 to 30 lb of seeds per acre or 6 to 10 lb in 24- to 30-in. rows. As a perennial protective cover crop the preferred method is to plant in 36-in. rows and allow a full season of growth before establishing woody or other herbaceous perennials between the rows. Tall fescue may be mixed and seeded along with herbaceous legumes. However, if wildlife graze a planting, the very palatable legumes, such as clover, will disappear.

Planting dates vary with the climate from south to north. Fall planting dates are best; a 2-month period starting approximately 6 weeks before the first expected frost is recommended. In the spring, seeding should start about 6 weeks before the last expected frost.

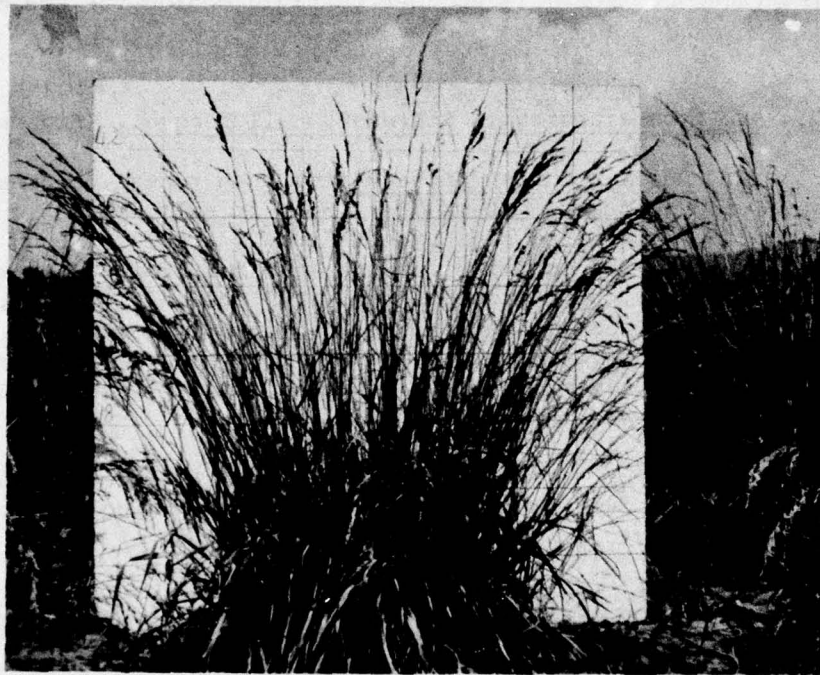


Figure 86. *Festuca arundinacea*, tall fescue. Habit. (SCS photo)

In the spring it is especially important that the seeds be planted at an early date. Seedlings must have time to develop a good root system before hot, dry summer weather begins.

Still another way of handling tall fescue is to include it with a fall broadcasting or row planting of small grain. The grain will give quick cover and provide protection and mulch for a spring inter-planting of woody or herbaceous seed or nursery stock. As the grain fades out it will be replaced by the fescue.

Tall fescue is usually top dressed with fertilizer annually. For wildlife habitat on dredged material this would probably be impractical. If the situation warrants attention, however, a complete fertilizer, preferably one high in nitrogen, will give quick response. The grass tends to become clumpy if not mowed or grazed off at least once every 2 years.

e. Disease and Insect Problems. One of the most troublesome diseases to attack tall fescue is *Rhizoctonia*, a fungus which appears in summer and gives the appearance of hot grease having been spattered on the leaves. It is a common soil-borne fungus which requires warm moist conditions and is damaging but seldom fatal.

f. Wildlife Value. Low to medium food value; low cover value. This tall, evergreen grass provides primarily fresh browse but some seeds to a variety of wildlife, including geese, wild turkey, sparrows, finches, towhees, cottontail rabbits, small rodents, mule deer, elk, and moose. (Martin et al. 1951). Tall fescue does well as an early protective cover crop planted with other grasses and legumes.

288. *Festuca rubra* L., red fescue. (Figure 87)

a. Description and Life History. A creeping, hardy robust plant, that forms a dense sod. The 16- to 40-in.-tall stems are usually bent at the reddish or purplish base. Plants spread by short underground stems. The smooth, bright-green leaves are wiry and narrow. They are folded together in a "v" shape and appear nearly round. The panicle seed head is contracted or narrow.

Several improved varieties, such as "Pennlawn", "Clatsop", and "Illahee" are available.

b. Habitat. Partial shade to full sun; cultivated pastures, meadows, orchards, bogs, marshes, erosion control plantings.

c. Soil Requirements. Moist to well drained; ample moisture required for establishment; once established it is drought resistant; pH 5.0 to 8.0; sands, sandy soil, sandy loams, silts.



Figure 87. *Festuca rubra*, red fescue. A, habit x 0.5; B, spikelet x 5; C, floret x 5.

d. Establishment and Maintenance. Seeds are commercially available. Red fescue is not usually planted in pure stands but rather mixed with various grasses and legumes depending on the intent of the planting. The rate and dates of planting, seedbed preparation, fertilizing, etc. are determined by the companion species in the planting mixture. Usually red fescue constitutes 25 to 60 percent of a mixture by weight. In plantings for shaded areas, red fescue is often the key grass in the mixture. Though it is not essential for dredged material sites, annual application of a complete fertilizer is generally recommended (USDA-SCS 1969-1976).

e. Disease and Insect Problems. None.

f. Wildlife Value. Low to medium food value; low cover value. Red fescue is only a little less tall than tall fescue but grows otherwise equally dense and robust. Like tall fescue, it is often grown in a mixture with other grasses and legumes. Its use by wildlife for food and cover is also much the same as for tall fescue.

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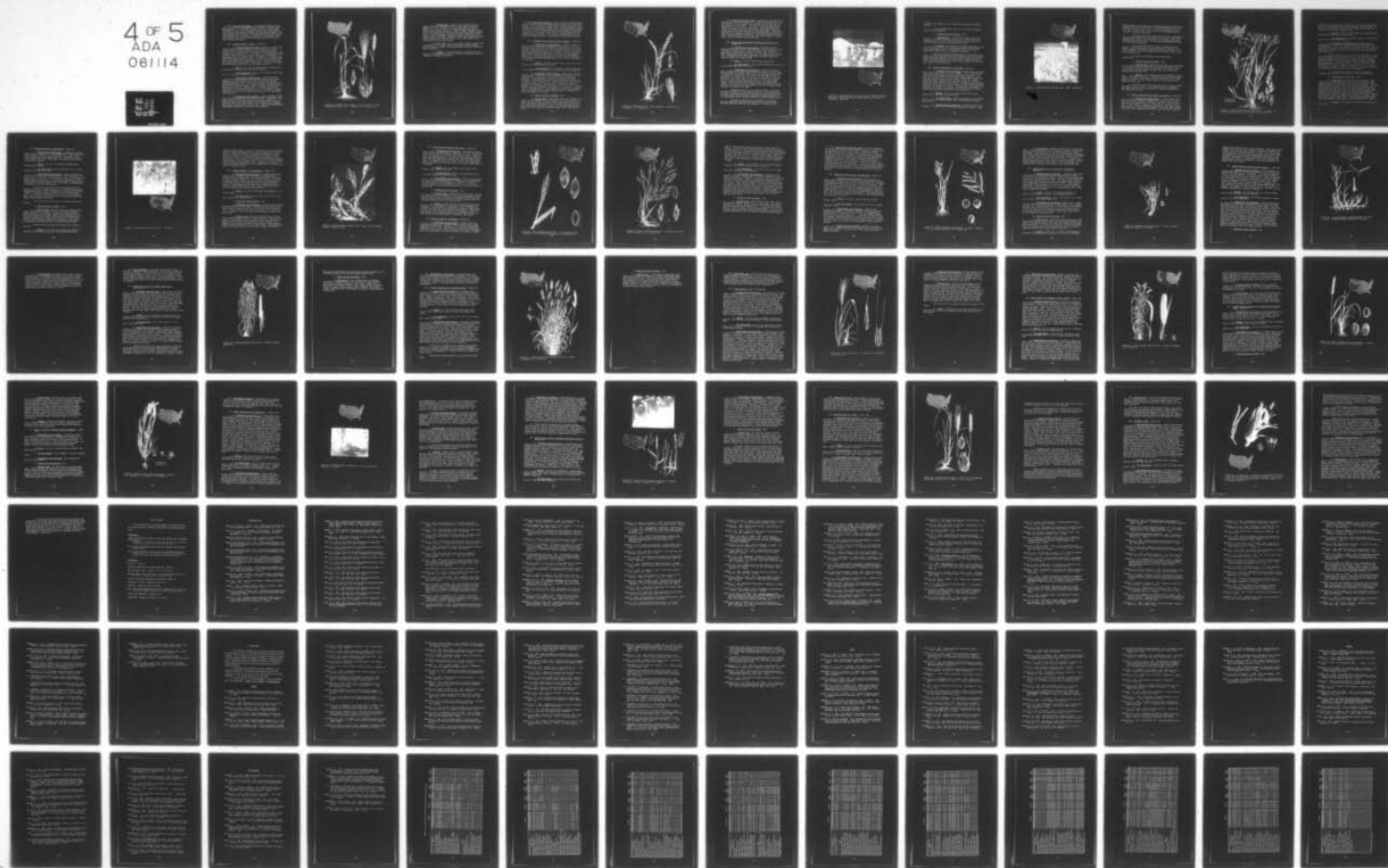
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289. Genus *Hordeum*, barleys. A predominantly temperate region genus, barley consists of approximately 20 species of tufted annuals and perennials. It is generally regarded as the most ancient cultivated grain. Barley is an extraordinary cereal crop; it can adapt to high altitudes, cold weather, droughts, and short growing seasons. The cultivated varieties are grown for livestock feed and for seeds, which, when germinated, are called malt, an ingredient of beermaking. Like oats and wheat, barley is classified agronomically into winter and spring types (Schery 1952).

290. *Hordeum vulgare* L., barley. (Figure 88)

a. Description and Life History. Barley is an annual with flowering stems or culms attaining 3 to 4 ft when grown on moist, fertile soils. The leaves differ from other cereal grains by the presence of leaf tissue lobes at the juncture of blade and sheath. The seed head varies from about 2 to 4 in. long. Stiff, bristlelike appendages may or may not occur on the bracts surrounding the flowers, depending upon the cultivated variety. Flowering of an individual head begins about midway between the base of the head and the tip and continues in both directions for approximately a week. When the grains are mature the bracts usually adhere to the kernel. At maturity the grains are characteristically arranged in six longitudinal rows.

b. Habitat. Full sun; cultivated fields, roadsides, and occasionally on waste ground, barnyards, and feedlots.

c. Soil Requirements. Moist to well drained to partly dry; pH 5.3 to 7.5; fertile, deep-loam soils.

d. Establishment and Maintenance. Approximately 150 varieties of barley are grown within the United States. The minimum temperature at which germination can occur is about 38°F and the optimum temperature is 68°F. The cultural practices for agricultural production of barley are similar to those of wheat. Fertilizer requirements are also similar to those of wheat with plants responding to applications of nitrogen and phosphorus. The average rate of seeds required for 1-acre plantings ranges from 1.2 to 2.2 bushels. Seeding depth should be 1 to 2 in. in humid regions and 2 to 3 in. under semi-arid conditions.

e. Disease and Insect Problems. Leonard and Martin (1963) list the following diseases as occurring on barley: covered smut, nuda loose smut, nigra loose smut, stem rust, leaf rust, stripe rust, powdery mildew, fusarium head blight, stripe, spot blotch, net blotch, bacterial leaf blight, scald; several viral diseases; ergot, anthracnose, root rot, downy mildew, and leaf spot. Insects that damage barley are greenbug, Hessian fly, chinch bug, and grasshopper.



Figure 88. *Hordeum vulgare*, barley. A, habit x 0.5; B, bearded and beardless spikes x 0.5; C, spikelet x 3; D, floret x 3.

f. Wildlife Value. Medium to high food value, low to medium cover value. Barley is eaten by a wide range of birds and mammals, but not as extensively or by as many species as feed on wheat, corn, and oats. Barley is a choice food for such species as the black duck, mallard, wood duck, pintail, gadwall, shoveler, Canada goose, white-fronted goose, mourning dove, white-winged dove, sandhill crane, Hungarian partridge, ring-necked pheasant, California quail, mountain quail, wild turkey, blackbirds, crows, jays, sparrows, towhees, ground squirrels, and wild mice (Martin et al. 1951, Davison 1967). Waterfowl also feed on young plants.

The cover value will vary according to height, density, age, and condition of the stand. Barley would be best used on dredged material areas as a wildlife food planting where intensive game management is warranted.

g. Comments. Cultivated barley is an Old World native brought to the New World and grown along the New England coast from the beginning of European colonization.

291. Genus *Lolium*, ryegrass. The five species of ryegrass known in this country have all been introduced from Europe and all hybridize freely. All are considered somewhat weedy. They are annuals or perennials with short rhizomes or hardened bases. Perennial ryegrass (*Lolium perenne*) is the oldest known pasture grass to be cultivated in Europe. It is not as robust or as long lived as Italian ryegrass (*Lolium multiflorum*) but is an adaptable species worthy of consideration for some dredged material plantings. Both perennial ryegrass and Italian ryegrass are extremely important forage grasses, particularly in Europe.

292. *Lolium multiflorum* Lamarck, Italian ryegrass. (Figure 89)

a. Description and Life History. An annual, biennial, or short-lived perennial grass (depending on the climate) to 2 to 3 ft with cylindrical stems and glossy foliage turning pale or yellowish at the base. Leaf blades are up to 10 in. long and 0.08 to 0.4 in. wide. There are numerous long, narrow, stiff leaves at the base of the plant. The distinctive fruiting stems appear from April to July; flattened spikelets are arranged in one plane in an alternating arrangement on either side of the main flowering stem. Italian ryegrass grows best in cool, moist regions that have mild winters, but it is not restricted to such areas.

b. Habitat. Full sun; pastures, lawns, road banks, roadside ditches, erosion-control plantings.

c. Soil Requirements. Wet to moist to well drained; pH 5.5 to 7.5; medium to high fertility agricultural soils, widely adaptable.

d. Establishment and Maintenance. Commercially produced seeds are readily available. Italian ryegrass may be sown in the fall or early spring. Where winters are severe, spring plantings are preferred. In more temperate regions fall plantings are usually successful. The seeds may be hand planted or drilled at a rate of 20 to 25 lb per acre if seeded alone. Italian ryegrass is often included in mixtures to give quick cover for longer lived plants, such as legumes. If a mixture is being planted, 8 to 10 lb of Italian ryegrass seeds per acre is recommended. Seeds should be planted 0.5 in. deep on a fine, firm surface with a compact subsoil for best results. Application of a balanced fertilizer when seeds are planted is beneficial (USDA 1948, USDA-SCS 1969-1976).

e. Disease and Insect Problems. None.

f. Wildlife Value. Medium food value; low to medium cover value. The green blades of Italian ryegrass are excellent browse in winter and early spring for wintering ducks, geese, and coots, as well as for wild turkey, and probably for other upland game birds and for small land birds and mammals in general. All of these groups of wildlife also eat the seeds, when available (Martin et al. 1951, Davison 1967).

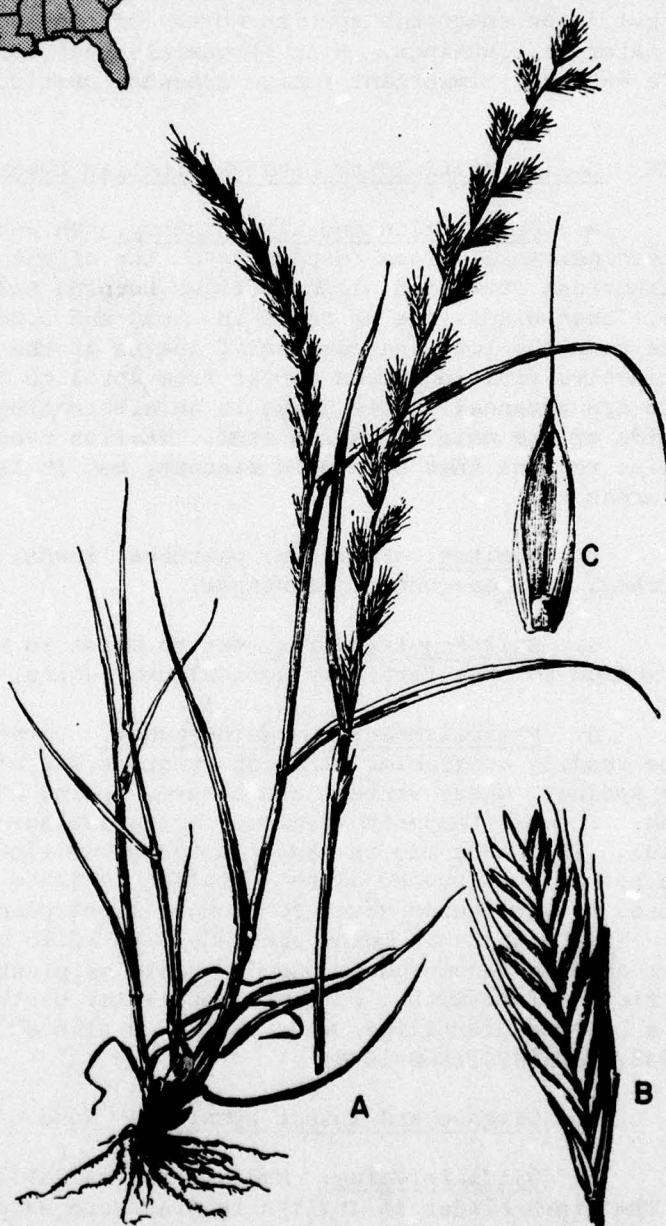
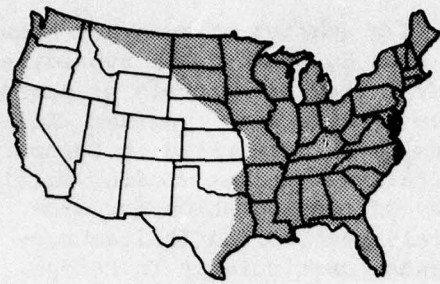


Figure 89. *Lolium multiflorum*, Italian ryegrass. A, habit x 0.5; B, spikelet x 3; C, floret x 5.

293. Genus *Panicum*, panic grasses. Approximately 160 species of *Panicum* grow in the United States. As a group they represent one of the most important wildlife foods. They are found in every state and are most abundant in the Southeast. The plants are mainly inhabitants of upland sites, but many thrive in low areas. In the fall many species develop low-growing rosettes of leaves which remain green during the winter and provide winter sustenance for browsing animals. Consistently excellent seed production provides a very important source of food for ground-feeding songbirds and gamebirds. The species discussed below are some of the most valuable, but there are many others adapted to various areas, as well as diverse growing conditions.

294. *Panicum amarulum* Hitchcock and Chase, shoredune panicum.
(Figure 90)

a. Description and Life History. An upright, coarse, bunchy perennial to 3 to 6 ft. The stems are as much as 0.38 in. thick, 6 ft tall, and bluish chalky. Roots are coarse, wiry, and deeply penetrating. Leaf blades are bluish, 8 to 16 in. long, 0.25 to 0.5 in. wide, and somewhat rolled inward and hairy on the upper surface near the base. The seed head is slightly compressed, elongated, chalky blue, slightly nodding, and densely seeded.

b. Habitat. Full sun; sandy shores, coastal dunes.

c. Soil Requirements. Moist to well drained to dry; pH 5.6 to 8.0; sand, sandy loam, silt, clay.

d. Establishment and Maintenance. Shoredune panicum is easy to propagate from seeds which are collected when ripe in the fall. The seeds must be thoroughly cleaned since the percentage of empty husks is quite high. Plant about 3 weeks before the last expected frost in the spring. The seeding rate is 15 lb per acre broadcast or 5 to 7 lb per acre in 24- to 36-in rows. Seeding depth is important and should be 0.5 in. on the finer textured soils to 2.5 to 3 in. deep on dune sands. At this extra depth the moisture supply is greater and more constant, and the initial roots of seedlings are less liable to dry out and die. As a result of this requirement, a drill or row seeder is much preferred to broadcasting by hand.

Shoredune panicum is slow in getting started. If the site is exposed and subject to wind and water erosion, a protective cover crop will be needed; an annual millet planted during the previous summer or a small grain planted in rows or broadcast the previous fall or in the spring along with the shoredune panicum will provide adequate cover.

The chance of success will be increased by the use of fertilizer applied at planting time--either in the row or broadcast. Soil tests should be taken for large plantings. If testing is not

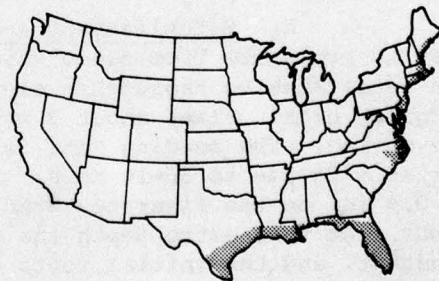
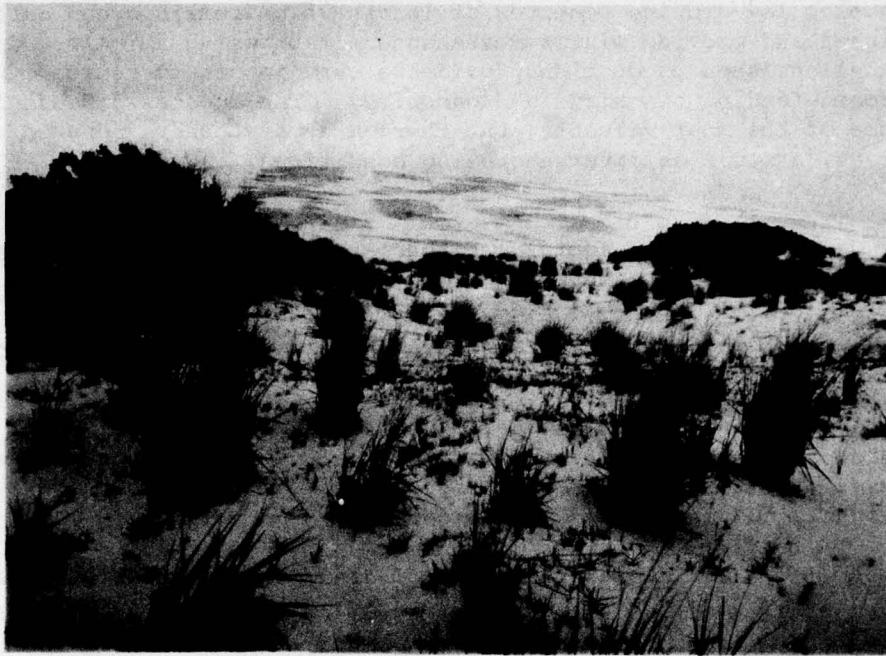


Figure 90. *Panicum amarulum*, shoredune panicum. Clumps of grass on dune sand in foreground, bayberry (*Myrica pensylvanica*) shrubs in background. (SCS photo)

possible, apply about 500 lb of 10-10-10 fertilizer per acre before seeding.

Once established this grass will not require additional fertilizer or maintenance.

e. Disease and Insect Problems. None.

f. Wildlife Value. Low food value; medium cover value. The seeds of shoredune panicum are known to be a choice food of the mourning dove, junco, and field sparrow and are potential food for a much wider range of wildlife species (Davison 1967).

g. Comments. One selection of shoredune panicum (N. J. 49) is being produced at the SCS Plant Materials Center, Big Flats, New York. These seeds will go out to producers in 1978, and limited quantities of seeds should be available by 1979-1980.

There is an unexplainable peculiarity in the range of this plant. It occurs along the coast from New Jersey to the Outer Banks of North Carolina and then skips all the way down to Florida and the Gulf coast. The general opinion is that plantings on dredged material in South Carolina and Georgia will succeed. Tests on such sites along the Gulf coast have been successful.

295. Panicum clandestinum L., deertongue. (Figure 91)

a. Description and Life History. A warm season grass which forms large, dense clumps 2 to 5 ft in summer. It is a perennial with fairly upright stems which are hairy at least below the joints. The heavy root system sometimes develops short, strong rhizomes. Leaves are 4 to 8 in. long, 0.5 to 1.25 in. wide, rough on both surfaces, and with hairy sheaths clasping around the stem. In the fall, summer growth dies and is replaced with a whorl-like rosette of low-growing leafy stems which stay green during winter. Two seed crops are produced annually--an early crop on a few open terminal panicles and a later crop enclosed by the swollen leaf sheaths. The early crop is negligible, but the second crop produces an abundance of seeds hidden under the leaf sheaths where they are protected from early shattering.

b. Habitat. Full sun to partial shade; waste places, eroded areas, road banks, woodland borders.

c. Soil Requirements. Imperfectly drained to well drained; pH 4.5 to 7.0; poor sandy or eroded soils of finer texture to moist, fertile soils.

d. Establishment and Maintenance. Deertongue seeds may be dormant. To overcome this condition fall planting is in order. A late



Figure 91. *Panicum clandestinum*, deertongue. Habit. (SCS photo)

winter planting is even better since it reduces the time in which fall-planted seeds might be washed away. Broadcast seeding rate is 12 to 15 lb per acre or the rate is 6 to 8 lb per acre if planted in 2- to 3-ft rows. Seeding depth is about 0.5 in. on fine-textured soils or 0.75 to 1 in. deep in sandy soils.

The grass has a high tolerance for acid soils. The application of lime to correct high soil acidity will usually be difficult on dredged material sites. The alternative is the use of a plant which can endure the acid condition. In this respect, deertongue would seem to be one of the best choices.

For grasses the use of fertilizer at planting time is usually of greater importance than the application of lime, and the amounts needed do not present a formidable task of application. If it is not possible to have soil tested, use 400 to 500 lb of 10-10-10 per acre at planting time.

No additional maintenance is anticipated after establishment.

e. Disease and Insect Problems. None.

f. Wildlife Value. Medium food and cover value. The seeds of this native panicum of the eastern and central states are known to be a choice food of birds such as the mourning dove, cardinal, junco, field sparrow, and white-throated sparrow, and a fair food of the bobwhite quail (Davison 1967).

g. Comments. This species germinates and emerges with good vigor. With moderate fertility it makes fast growth during the summer months. Tall summer growth tends to lodge and break off at the ground during the winter. For this reason it may not be well suited for a protective cover crop.

Individual plants in the wild vary widely in height, rhizome development, and seed yields. Work to select the best is underway. One variety called "Tioga" was released for commercial production in 1975 (USDA-SCS 1969-1976).

296. Panicum dichotomiflorum Michaux, fall panicum. (Figure 92)

a. Description and Life History. A coarse, summer annual grass with stems ascending or spreading, 20 to 40 in. tall or up to 6 ft long in robust specimens. Stems are thickened and rather sharply bent at large, knucklelike joints. Leaves are to 2 ft long, 0.13 to 0.75 in. wide, and have a dense ring of white hair where they join the stem. Blades are rough, sometimes sparsely hairy on the upper surface, and usually with a prominent white midrib. Seed heads occur along the



Figure 92. *Panicum dichotomiflorum*, fall panicum. A, habit x 0.5; B, branch with spikelets x 7.5; C, ligule x 4; D, grain x 7.5.

stem as well as at stem tips. They are 4 to 16 in. long or more and 4 to 6 in. wide with many seeds widely diffused. Seeds are small--less than 0.13 in. in length. They do not deteriorate in the field over winter and volunteer the following spring.

b. Habitat. Full sun to half shade; along streams, ponds, waste places, crop fields, disturbed areas.

c. Soil Requirements. Imperfectly drained to well drained; pH 5.5 to 7.5; sandy loam, silt, clay.

d. Establishment and Maintenance. Fall panicum is a reseeding annual. Seeds most likely will be gathered by bending the long stems over trays or tubs and beating off the seeds with sticks. In crop fields seeds may be combined after stems dry. Very often, seeds of weedy species which occur in crop fields can be had for the asking at seed-cleaning mills.

Seeds are planted in the early spring using about 4 to 5 lb per acre broadcast or 2 lb per acre in rows. When small lots of seeds are to be broadcast uniformly over a large area the seeds should be thoroughly mixed with some other small granular material to give more bulk to work with. Damp sifted sawdust is one of the best dilutants. The seeds require only a light 0.5-in. or less soil covering. Fall panicum will grow best in damp areas and along the edges of the excavated material. Growth is vigorous, especially if some fertilizer high in nitrogen is used at planting or even in midsummer.

In some cases, maintenance in the form of light soil disturbance may be required occasionally to improve volunteering.

e. Disease and Insect Problems. None.

f. Wildlife Value. Medium food and cover value. Fall panicum grows on both moist and drier sites, and its seeds are eaten by both waterfowl and marsh birds as well as by upland birds. When growing in damp places like river, pond, and lake shorelines, the seeds often fall or are washed into the water where wind and waves collect them in small windrows where they are readily obtained by ducks and shorebirds. The seeds are a choice to fair food of the Canada goose, mallard, pintail, gadwall, black duck, mottled duck, bufflehead, shoveler, blue-winged teal, green-winged teal, bobwhite quail, mourning dove, towhee, junco, and a number of the blackbirds, sparrows, grosbeaks, and buntings (Davison 1967). Muskrats and cottontail rabbits are likely foragers on the plants and foliage (Martin et al. 1951).

g. Comments. Fall panicum is regarded as a weedy pest in crop fields.

297. Panicum miliaceum L., proso millet. (Figure 93)

a. Description and Life History. A warm season, annual grass with erect stems to 4 ft. Leaf blades more or less hairy on both sides or smooth, as much as a foot long and 0.75 in. wide. Large, loose, drooping seed heads ripen in the fall. The seeds are 0.13 in. long, shining light tan to reddish brown. They mature approximately 120 days after planting.

b. Habitat. Full sun; cultivated for wildlife food, occasionally for forage.

c. Soil Requirements. Moist to dry; pH 5.0 to 7.0; thin sandy soils to loam, silt, clay.

d. Establishment and Maintenance. Seeds are planted any-time during the spring at the rate of 20 lb per acre broadcast or 6 lb per acre in 2- to 3-ft rows. Planting depth is 1 to 1.5 in. deep on the lighter sandy soils and to 0.5 in. on the finer textured soils. The planting date is often selected so that seed ripening will coincide with the opening of the hunting season; thus, proso millet is planted about 4 months before the first shooting date.

It is best to plant seeds on a firm seedbed; such will usually be the case on dredged material sites. During the fertilizing and planting operation, the soil firmness should be retained as much as possible. Deep disking should be avoided. A very shallow disking (2 to 3 in.) to work in required fertilizer and lime is often unavoidable. Drilling seeds and fertilizer in the row without disturbing row middles is an excellent alternative.

After the initial fertilization, no further maintenance is required.

e. Disease and Insect Problems. None.

f. Wildlife Value. High food value; low to medium cover value. Proso millet is a choice food of a wide range of waterfowl, upland game birds, and songbirds. Users include the Canada goose, American wigeon, mallard, shoveler, gadwall, green-winged teal, wood duck, coot, bobwhite, wild turkey, mourning dove, white-winged dove, cardinal, painted bunting, purple finch, dickcissel, towhee, house sparrow, chipping sparrow, field sparrow, fox sparrow, song sparrow, tree sparrow, white-throated sparrow, and cowbird (Davison 1967).

The cover value of proso millet depends on the density of the stand.

g. Comments. In the past, most proso millet production took place in the northern states with strains adapted to the day

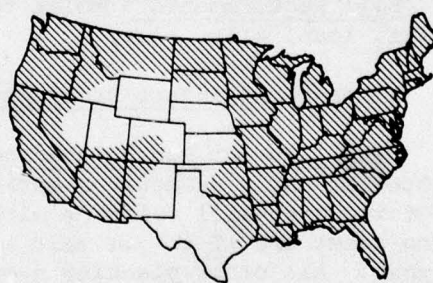


Figure 93. *Panicum miliaceum*, proso millet. (SCS photo)

length in those latitudes. When those strains were tried in the South they were dwarfed and unproductive. A large collection of the species was made in India and tested at the USDA-SCS Plant Material Center, Americus, Georgia. Out of these, three were well suited to the day length in the South. One was finally selected and named dove proso. It has pale tan-yellow seed and, with good soil and moisture conditions, produces about a ton of seeds per acre. Dove proso is readily available commercially from southern seed dealers. Proso millet is used extensively in songbird food mixtures. It is reported to be the oldest grain cultivated by man for food.

298. Panicum ramosum L., browntop millet. (Figure 94)

a. Description and Life History. A summer growing annual grass usually less than 3 ft tall with erect or spreading stems ascending from a decumbent base. The stems are smooth but the joints or nodes are hairy. Leaves are 1 to 7 in. long, 0.25 to 0.7 in. wide, and smooth on both surfaces. The leaf margins are rough and margins of the sheaths hairy. Seed heads are partly inserted in the leaf sheaths. Browntop millet flowers and fruits in summer and early fall. The tawny or dull-brown seeds are flat, elliptic, less than 0.13 in. long, and they ripen about 90 days after planting.

b. Habitat. Full sun to half shade; cultivated crop, low fields, woods.

c. Soil Requirements. Moist to dry; pH 5.0 to 7.5; dune sand, sandy soils, loam, silt, clay.

d. Disease and Insect Problems. None.

e. Establishment and Maintenance. Browntop millet is grown from seeds planted in early summer. Planting dates are usually set so that the time of ripening will coincide with the arrival of migratory birds. Planting rates are 25 lb per acre broadcast or 10 lb per acre in 2- to 3-ft rows. All other planting procedures are the same as for proso millet.

f. Wildlife Value. Medium to high food value; low cover value. Browntop millet is similar to proso millet as a food plant for wildlife. The documented use of its seeds as food for a wide array of birds and of both its seeds and foliage as food for waterfowl and mammals, is only slightly less than for proso millet. Thus, browntop millet is eaten extensively by geese, dabbling ducks, upland game birds, blackbirds, sparrows, finches, mourning dove, cardinal, and towhee.

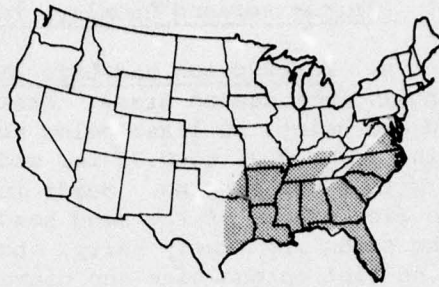


Figure 94. *Panicum ramosum*, browntop millet. Habit. (N. C. Wildlife Resources Commission photo)

299. Panicum texanum Buckley, Texas millet. (Figure 95)

a. Description and Life History. A decumbent or partly erect, annual, warm season grass. Stems are 5 ft or more, root at the nodes, and are hairy, at least below the nodes or joints. Leaves are up to 10 in. long, 0.25 to 0.75 in. wide, with fine hairs on both surfaces and with rough margins. Seeds in the loose seed heads occur in pairs; the fine stalks of the seed head have both long and very short hairs. The seeds are finely hairy, about 0.19 in. long, oblong and pointed, and flat on one side and convex on the other. Seeds ripen in late summer.

b. Habitat. Full sun; prairies, open ground, along streams, weeds in some field crops.

c. Soil Requirements. Moist to well drained; pH 5.4 to 7.8; sands, sandy soils, silt, loam, clay.

d. Establishment and Maintenance. Seeding date for Texas millet (also called Texas panicum) is in midspring to about midsummer. In eastern Texas the planting dates are from April 15 to August 15. The planting rate is 25 lb broadcast or 15 lb in 2- to 3-ft rows. All other planting and maintenance procedures are the same as those for proso millet.

e. Disease and Insect Problems. None.

f. Wildlife Value. Medium food and cover value. This hay and forage millet is quite similar to the other planted millets as food and cover for wildlife. Texas millet is consumed by many of the same wildlife groups and species as are proso millet, browntop millet, and fall panicum (Martin et al. 1951, Davison 1967).

g. Comments. Texas millet was originally found in Texas but has since been introduced to other states in the Southeast and Southwest. In some places it is regarded as a weed. The seeds ripen unevenly, and those that reach maturity shatter readily. Seed production is high, and it has the "exuberance" of crabgrass. Initial observations of two accidental occurrences on dune sand indicate that this species has excellent promise as a temporary sand stiller.

300. Panicum virgatum L., switchgrass. (Figure 96)

a. Description and Life History. A coarse, erect, and rhizomatous perennial grass sometimes forming luxuriant zones around ponds and wet depressions. Stems are 1.5 to 6 ft tall with roughened leaves about 0.5 in. wide. Blade hairs are variable in location and abundance but usually occur along the margins, at the base of the blade, and on the blade sheath. Flowering occurs from late spring to middle



Figure 95. *Panicum texanum*, Texas millet. A, seed head and leaf; B, panicle x 1; C, two views of spikelet x 10; D, floret x 10.

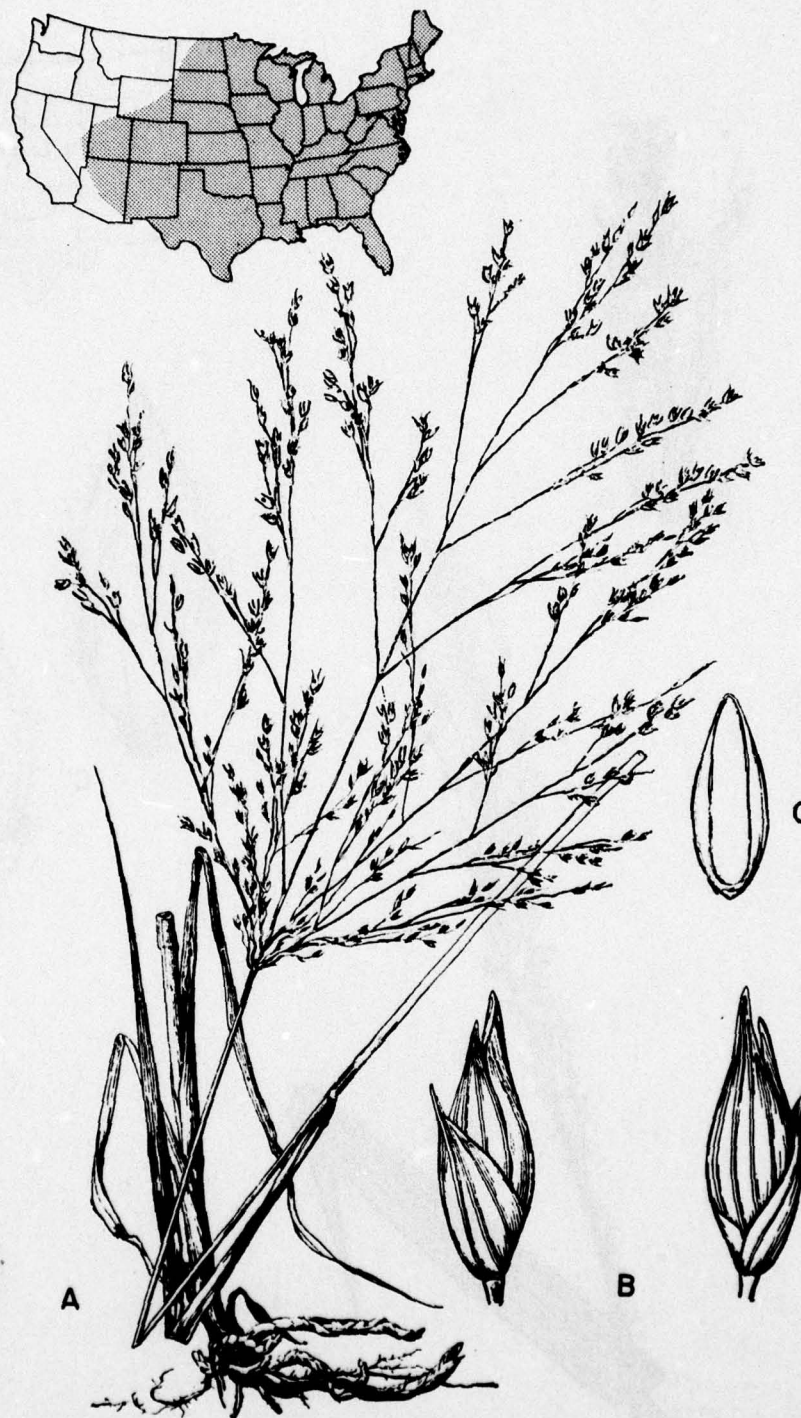


Figure 96. *Panicum virgatum*, switchgrass. A, habit x 0.5; B, two views of spikelet x 10; C, floret x 10.

summer. The seed head is much more open than in other species of *Panicum*. The total length of the head may be as much as 20 in. and the width up to 5 in. The spikelets are small and located on the tips of long inflorescence branches. After the seeds are shed, the seed head persists, even after frost has turned the leaves brown. Seeds are grayish, about 0.05 in. long. In relatively pure stands, seed production is 100 to 150 lb per acre. However, many of the harvested seeds are sterile, a fact which should be taken into account in planting programs.

b. Habitat. Full to almost full sun; brackish marshes, savannahs, waste areas, sandy pond margins, prairies.

c. Soil Requirements. Wet to dry; pH 5.0 to 7.6; muck, peat, sand, sandy loam, limestone soils.

d. Establishment and Maintenance. Switchgrass can be seeded or sprigged. Because seeds are available commercially, this method is preferable to sprigging. If seeding, allow for a high proportion of inviable seeds. Germination percentages should be checked carefully. Planting rates are approximately 25 lb broadcast or 15 lb in 3-ft rows. Other planting procedures and maintenance requirements are similar to those for proso millet. Sprigs can be planted in 3-ft rows also, fertilized lightly at planting time, and again a few weeks after the plants have shown signs of growth. Plantings should be done in early spring since switchgrass grows most from March through September. The rhizomes are active during the period January through April. Switchgrass can withstand temperatures of -25° to -30°F (Leithead et al. 1971).

e. Disease and Insect Problems. None.

f. Wildlife Value. Medium food and cover value. This tall, coarse, perennial native grass is a choice food of the bobwhite, mourning dove, cowbird, cardinal, junco, field sparrow, tree sparrow, and white-throated sparrow (Davison 1967). It is potentially a good food for a much wider range of birds and some mammals. It is used for roosting, nesting, and escape cover by lesser prairie chickens in Texas (personal communication, Dr. John Crawford, Oregon State University).

301. Genus Paspalum, paspalum grasses. Though the paspalums are closely related to the panic grasses (*Panicum*), the wildlife value for the genus as a whole is not as great. Paspalums are found throughout the eastern and central states and the Pacific coast but are most plentiful in the Southeast. Fringeleaf paspalum (*Paspalum ciliatifolium*) and field paspalum (*Paspalum laeve*) are abundant and widespread in the East. Dallis grass (*Paspalum dilatatum*) is a perennial forage type for damp pastures. The common vaseygrass (*Paspalum urvillei*) is also a perennial on damp to wet sites. It is a vigorous plant with tall seed stems. In addition to these species, there are approximately 54 other species in the United States which may be suitable for establishment on a variety of dredged material sites. The seeds of most are consumed in varying amounts by many kinds of wildlife.

302. *Paspalum boscianum* Fluegge, bull paspalum. (Figure 97)

a. Description and Life History. Bull paspalum is a coarse, stout annual to 6 ft. The plant is tufted when young and the basal leaves are somewhat softer than the upper stem leaves. The stems are numerous and branch from the base of the plant at an angle. Stem leaves are near the base only and are 10 to 16 in. long and 0.5 in. wide. The leaf sheaths are loose and frequently purplish. The inflorescence consists of 2 to 15 branches, each branch with two rows of paired spikelets, thus giving the branch the appearance of having four rows. The spikelets and grains are suborbicular. The grains are 0.06 to 0.07 in. long and are grayish or dark brown. Flowering and fruiting occur from June until frost.

b. Habitat. Full sun to partial shade; low fields, ditches, shores.

c. Soil Requirements. Wet to moist; pH 5.0 to 7.5; muck, sandy peat, sands.

d. Establishment and Maintenance. Commercial seed supplies are probably not available. Therefore existing plants must be harvested by hand or by mowing and threshing the seedheads over burlap or canvas. Storage in a cold, dry place will improve germination; prior to planting, treatment for a few minutes in sulfuric acid is advisable. Spring seeding by hand in small plots and use of fertilizer such as 8-8-8 or 10-10-10 will produce vigorous plants. Occasional moving and thinning may enhance the attractiveness of the species to wildlife.

e. Disease and Insect Problems. Members of the genus *Paspalum* are in general subject to ergot fungus, resulting in inviable seeds. This disease is not likely to be a major problem with bull paspalum plantings.

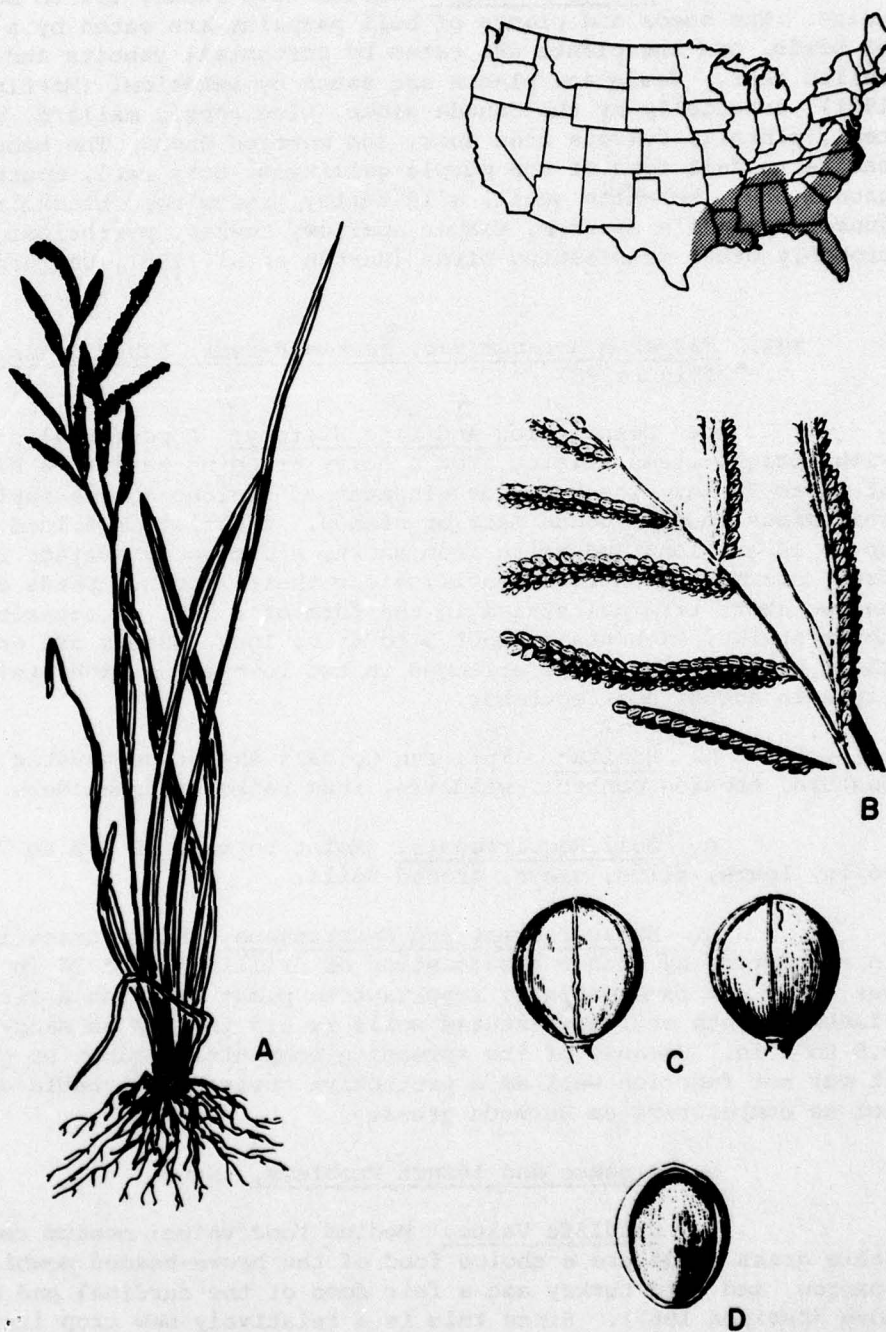


Figure 97. *Paspalum boscianum*, bull paspalum. A, habit; B, panicle x 1; C, two views of spikelet x 10; D, floret x 10.

f. Wildlife Value. Medium food value; low to medium cover value. The seeds and plants of bull paspalum are eaten by a wide range of birds, and the plants are eaten by cottontail rabbits and white-tailed deer. Seeds and plants are eaten by waterfowl (Martin and Uhler 1951), especially by the Canada goose, blue goose, mallard, green-winged teal, pintail, fulvous tree duck, and mottled duck. The seeds are a choice to fair food of the purple gallinule, sora rail, mourning dove, ground dove, bobwhite quail, wild turkey, red-winged blackbird, cowbird, junco, Bachman's sparrow, vesper sparrow, towhee, pyrrhuloxia, and probably other seed-eating birds (Martin et al. 1951, Davison 1967).

303. Paspalum notatum var. sauræ Parodi, Bahia grass.
(Figure 98)

a. Description and Life History. A perennial summer grass with upright stems arising from a heavy creeping base to a height of 16 to 28 in. The heavy development of stolons on the surface enables this grass to form dense mats or stands. The flat or folded leaves are up to 14 in. long and arise from short, stout woody surface runners or from rhizomes which root heavily along their length. Seeds are borne on two short terminal stalks in the form of a "V", or occasionally three stalks, each stalk about 3 to 4 in. long. Seeds are orbicular, about 0.13 in. long, and arranged in two rows along each stalk. Seeds ripen in August and September.

b. Habitat. Full sun to half shade; cultivated for pasture, erosion control, wildlife, road banks and shoulders.

c. Soil Requirements. Moist to dry; pH 5.3 to 7.5; sandy soils, loams, silts, clays, eroded soils.

d. Establishment and Maintenance. Bahia grass is seeded in the spring by either broadcasting or drilling 20 to 30 lb of seeds per acre. It is especially important to plant seeds on a firm seedbed. Planting depth on fine-textured soils is 0.5 in. and on sandy soils 0.5 to 1 in. Because of its spreading competitive habit of growth, it may not function well as a protective cover crop. Bahia grass is not as competitive as Bermuda grass.

e. Disease and Insect Problems. None.

f. Wildlife Value. Medium food value; medium cover value. Bahia grass seeds are a choice food of the brown-headed cowbird, house sparrow, and wild turkey and a fair food of the cardinal and mourning dove (Davison 1967). Since this is a relatively new crop its potential value for wildlife has not been fully evaluated. The dense mats of stands can provide cover for small mammals and birds.

g. Comments. Bahia grass is a native of South America. Accidental occurrences in North America were originally found around

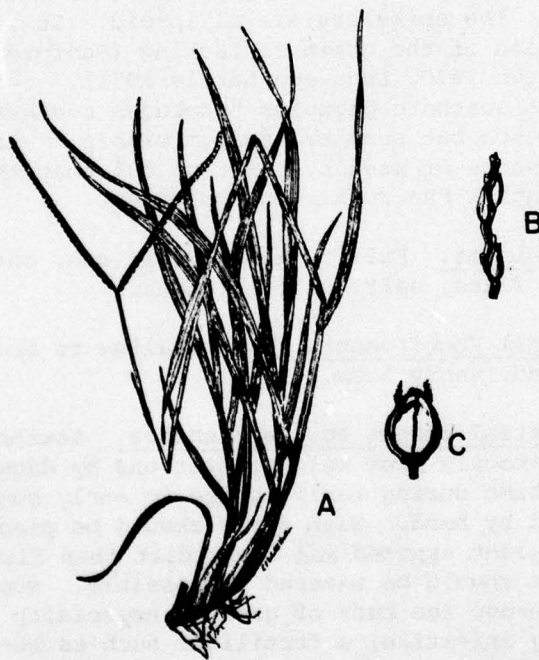
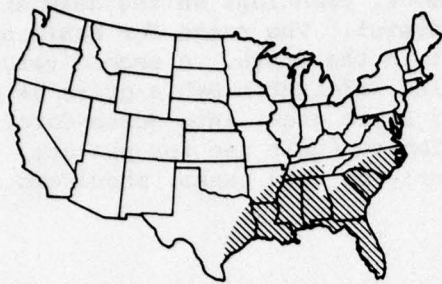


Figure 98. *Paspalum notatum*, Bahia grass. A, habit; B, raceme segment and spikelets; C, spikelet.

seaports where seeds had come in with ship ballast. Bahia grass is most abundant in the Coastal Plain; however, plantings on the heavier fine-textured soils have also been successful. The range for Bahia grass roughly follows the old cotton belt in the South. A second very important selection of this species called Wilmington Bahia grass is more cold-hardy and extends the range of Bahia grass into North Carolina, Tennessee, and Arkansas. In addition to their use for pasture, the Bahia grasses are now used extensively on road banks, shoulders, and medians for erosion control.

304. Paspalum vaginatum Swartz, seashore paspalum. (Figure 99)

a. Description and Life History. Seashore paspalum is a densely matted perennial, which is very difficult to distinguish from *Paspalum distichum* in coastal environments. The stems are commonly 4 to 16 in. tall and glabrous. The flowers and fruits are located in a "v"-shaped inflorescence which is characteristic, though not diagnostic, for this species. The spikelets are ellipsoid. In various regional floras a description of the grain is lacking (Radford et al. 1968, Correll and Johnston 1970, Long and Lakela 1971). Leithead et al. (1971) report that seashore paspalum "produces seedheads several times during growing season but seed are seldom viable." Graetz (1973) alludes to the absence of seed by pointing out that the plant is propagated by transplanting the runners or rhizomes.

b. Habitat. Full to almost full sun; coastal overwash sands, sandy salt flats, salt shrub thickets.

c. Soil Requirements. Wet (saline to brackish) to moist; pH 6.5 to 9.4; sand, sandy loam.

d. Establishment and Maintenance. Seashore paspalum may be transplanted directly from wild populations by digging the runners and rhizomes any time during early spring to early summer. They will have to be planted by hand. Each sprig should be placed in a small hole with half of the plant exposed and loose dirt then firmed around the plant. The plants should be watered if possible. Roots will form at the nodes. To improve the rate of growth, especially if the planting site is relatively infertile, a fertilizer such as 10-10-10 may be broadcast around the plants at the time of planting or within a few weeks after planting. Seashore paspalum is a well-adapted plant to coastal areas. Its tolerance to salt, ability to survive flooding, preference to grow on wet sand, response to fertilizer and mowing, capacity to reduce shoreline erosion, freedom from disease or insect damage, and aesthetic quality of forming a compact sod make seashore paspalum an excellent choice for coastal planting.

e. Disease and Insect Problems. None.

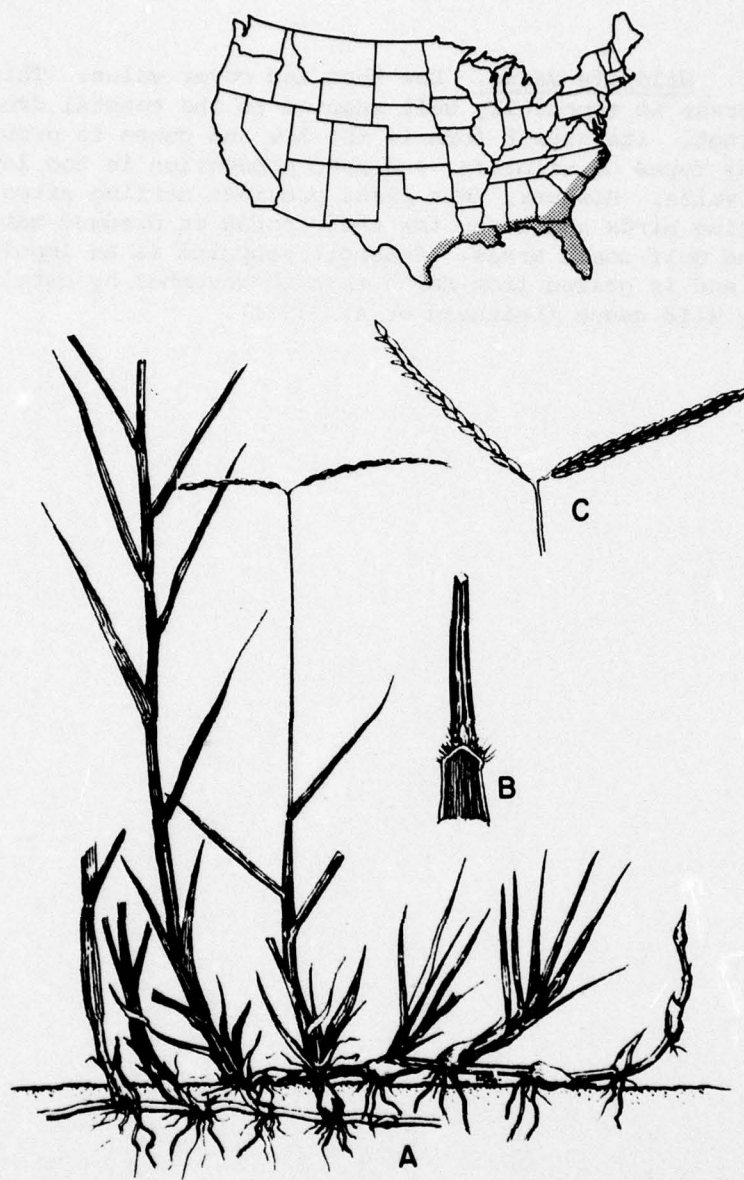


Figure 99. *Paspalum vaginatum*, seashore paspalum. A, habit; B, ligule; C, seedhead showing arrangement of spikelets.

f. Wildlife Value. Low food and cover value. This low, sod-forming grass is especially well adapted to the coastal dredged material habitat. Its growth form is too low and dense to provide cover for many types of wildlife, and seed production is too low to be of much food value. However, this plant provides nesting sites for colonial nesting birds and cover for their young on dredged material in Florida and Gulf coast areas. Seashore paspalum is an important forage plant and is grazed from March through November by cattle and horses and by wild geese (Leithead et al. 1971).

305. Genus Pennisetum. In the United States about a dozen species of the genus *Pennisetum* are grown. The plants are used mostly for forage, although in India and Africa they are cultivated for fiber and for human consumption. Most of the crop in this country is grown in the southern states, and pearl millet (*Pennisetum glaucum*) is by far the most important member of this small group of coarse grasses. Some of the species are potential weed pests, especially where soil fertility has declined.

306. *Pennisetum glaucum* (L.) R. Brown, pearl millet.
(Figure 100)

a. Description and Life History. Pearl millet is a robust African annual with stems 5 ft or more tall. Although this millet is a widespread cultivated seed and livestock feed crop, the plants seldom become naturalized and therefore must be resown annually. The leaves are mostly scattered on the stalk like those of corn, sugar cane, and other robust grasses. The blades are about 1.5 ft long and up to 1 in. wide; they are generally rough to the touch and have a leaf sheath that is typically hairy. The floral structure is an erect, very dense spike from which another common name for this crop, cattail millet, is derived. Each floret of the spike is surrounded by numerous barbed bristles. The grain is ovoid to obovoid and about 0.2 in. wide. Flowering occurs in late summer; seeds ripen in October and shatter soon thereafter.

b. Habitat. Full sun; fields and roadsides where it is frequently planted, escaping to field margins, waste heaps, barnyards, and other open disturbed sites.

c. Soil Requirements. Dry to very dry; pH 5.5 to 7.5; loams, sandy loam, sands.

d. Establishment and Maintenance. Seeds can be broadcast, drilled, or row planted, and soils need not be thoroughly plowed or disked for preparation of the seedbed. A common agricultural practice is to drill the pearl millet seeds in rows in stubble fields following harvest of small grains such as oats or wheat. If seeds are planted in fallow fields, a lister planter (a plow with an attachment for dropping seed into the furrow used especially where rainfall is limited) can be used. If rows are 4 ft apart, 4 lb of seeds per acre is adequate for planting; if rows are 20 to 42 in. apart, 5 to 6 lb of seeds is required for an acre planting (USDA 1948).

Although pearl millet is a rainy season crop in India and the African Sudan, the plants tolerate summer droughts and still produce a seed crop that is not appreciably diminished by dry weather conditions. Unless the soil is of very low fertility, pearl millet will not respond to application of nitrogen, phosphorus, and potash. Because

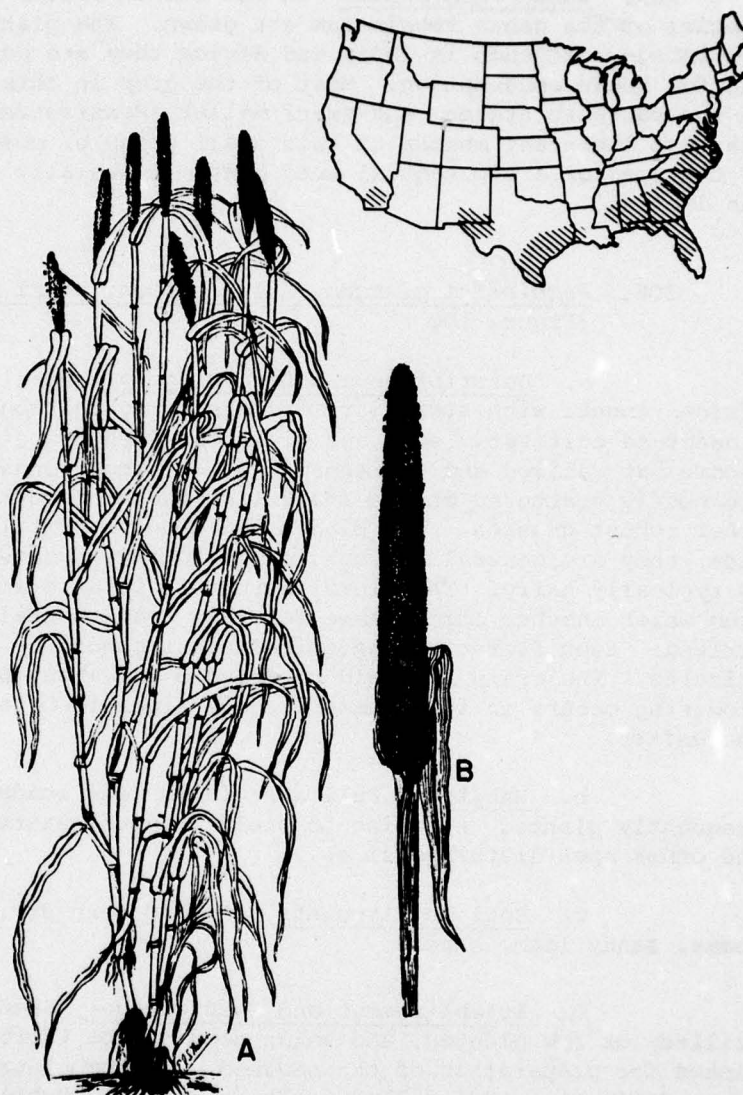


Figure 100. *Pennisetum glaucum*, pearl millet. A, habit; B, seed head x 0.25.

pearl millet needs minimum soil nutrients for survival and growth, it is an excellent selection for infertile dredged material areas.

e. Disease and Insect Problems. None.

f. Wildlife Value. Low to medium food value; medium cover value. The food value, at least potentially, may be more than the published information suggests. Pearl millet is known to be a choice food of the bobwhite, mourning dove, common grackle, red-winged blackbird, cardinal, blue grosbeak, towhee, goldfinch, junco, house sparrow, chipping sparrow, field sparrow, fox sparrow, and song sparrow (Davison 1967).

307. Genus Phalaris, canary grass. The genus *Phalaris* is a small temperate region group of annuals and perennials. The Canary Islands taxon (*Phalaris canariensis*) is grown commercially for birdseed whereas the variegated form of reed canary grass is grown for ornamental purposes. The flower and seed head is typically a dense cylindrical or globose structure, a convenience which facilitates mechanical or hand harvest.

308. *Phalaris arundinacea* L., reed canary grass. (Figure 101)

a. Description and Life History. A perennial grass, spreading by rhizomes, reed canary grass is a very adaptable species, growing well in moist lowlands, even swampy ground, or in dry soils as well. Clumps 3 ft across are common. The stems reach 3 to 5 ft high with a terminal inflorescence. The leaves are smooth or rough on both surfaces appearing alternately on the stems. The dense 2- to 8-in.-long seed heads are purplish, somewhat compact in appearance, but the branches tend to spread slightly at the time of flowering. The seeds are obovoid; glossy; black, brown, or gray; and shatter soon after ripening.

b. Habitat. Full sun to partial shade; moist fields, alluvial woods, stream banks, meadows, marshes, lake shores, and swales.

c. Soil Requirements. Moist to wet; pH 5.0 to 7.5; muck, peat, sandy silt, or sands.

d. Establishment and Maintenance. To prepare a seedbed for reed canary grass, weeds and grasses should be removed by plowing under during summer or early fall and the field allowed to stand fallow. As soon as weather permits in late winter or very early spring, the soil should be disked prior to planting. Seeds should be drilled or broadcast; if the latter, the soil should be firmed by drag, harrow, cultipacker, or similar equipment. Two to 5 lb of seeds per acre is recommended for planting, the surviving plants becoming thickened by tillering to form large clumps that may reach 3 ft across. Reed canary grass will be more robust in swampy or peaty soils, but will also thrive in upland sands. Its growth is most rapid during the cool spring months, and in the southern part of its range the plants may be winter-hardy, permitting late fall or winter plantings.

If the soil is extremely acidic, occasional lime applications of 2 to 4 tons per acre every 6 to 10 years are recommended. At the time of seeding, fertilizers should be applied as needed according to soil test recommendations. Occasional mowing will improve the forage quality.

Average seed yields are from 30 to 150 lb per acre (USDA 1948).



Figure 101. *Phalaris arundinacea*, reed canary grass. A, habit; B, spikelet x 4; C, floret x 4.

e. Disease and Insect Problems. None.

f. Wildlife Value. Low food value; medium cover value. Canary grass is known to be eaten by a number of upland game birds, such as the bobwhite quail, ring-necked pheasant, and mourning dove and songbirds, such as the lazuli bunting, pipit, towhee, junco, savannah sparrow, field sparrow, white-throated sparrow, and house sparrow (Martin et al. 1951, Davison 1967). Seeds of canary grass are probably eaten by a wider range of land birds than so far documented, as well as by mice and other rodents.

309. Genus Secale, rye. Four species native to Africa and Eurasia comprise the genus *Secale*. The value of cultivated rye as a human and wildlife food crop surpasses by far that of the remaining three rye species. In addition to the many cultivated strains, an intergeneric hybrid between rye and wheat has been developed and shows promise of becoming an agriculturally important crop of drier and cooler climates. Rye is also grown for soil stabilization.

310. *Secale cereale* L., rye. (Figure 102)

a. Description and Life History. The rye plant is a tufted annual, resembling wheat but with taller stems and bluer foliage. The stems of plants on fertile sites may be 3 to 4 ft tall. The roots are extensive, branch profusely near the soil surface, and grow to a depth of 5 or 6 ft. The heads are about the same size as wheat heads but the grains shatter readily. The grains are brownish to yellow and usually tinged with olive and ripen in late spring to early summer. Rye plants are largely self-sterile. Winter and spring varieties are grown but winter rye is the most hardy of all cereals with a tolerance to winter temperatures as low as 40°F below zero. The crop withstands a wide range of adverse weather with the exception of heat. Once the crop is established in colder regions the plants usually reseed and are difficult to completely eradicate. Only in the southern part of its range is natural reseeding unsuccessful.

b. Habitat. Full sun; fields, roadsides, barnyards and feedlots, often planted in drained marshlands or newly cleared timberland.

c. Soil Requirements. Moist to dry (annual precipitation 20 to 30 in.); pH 5.5 to 7.5 (6.0 to 6.5 optimum pH); fertile, well-drained loams and sands.

d. Establishment and Maintenance. In humid regions or where the soil is covered by weeds and grasses, fall plowing followed by drill planting is recommended. In drier areas the seeds may be sown by drill directly if the site is relatively free of weeds. A bushel and a half of rye per acre is adequate. Fertilization should be according to soil test recommendations. A general recommended fertilizer and rate of application is 8-8-8 at 300 to 400 lb per acre (Davison and Graetz 1957). Planting times vary from about 15 August in Minnesota to 1 October in Florida and throughout October in the area south of Kansas. Abruzzi rye, an Italian variety, is suitable for planting in the states south of a line that extends from Maryland to Oklahoma. Florida Black and Gator are varieties suitable for Florida, Georgia, and South Carolina. Balbo variety can be grown in Colorado and eastward to New Jersey. There are many other varieties well adapted to the northern tier of states. Rye will begin to germinate at a temperature as low as 33°F, but the optimum germination temperatures are 55° to 65°F. Winter rye requires cool temperatures, usually around 55°F to induce flowering. Rye ripens in late spring to early summer.



Figure 102. *Secale cereale*, rye. A, habit x 0.5; B, spikelet x 3; C, floret x 5.

e. Disease and Insect Problems. The major disease of rye is ergot, a fungus which attacks the seed head. Other diseases of rye include smuts, anthracnose, viral infections, and mildews. Insects that attack other cereal crops may infest rye. Plantings of rye for wildlife habitat development, particularly if mixed with other crops, will not be unduly damaged by disease and insect pests.

f. Wildlife Value. Medium to high food value; low to medium cover value. Rye is much like wheat in form and habit, with somewhat taller stems and more slender seed heads. In recent years, rye has become more widely planted and in larger amounts, escaping commonly to fields, roadsides, and waste places, thus becoming more and more a food for wildlife. The seeds and green leaves are eaten by a variety of dabbling ducks, whistling swan, coot, bobwhite, ring-necked pheasant, wild turkey, mourning dove, yellow-shafted flicker, common grackle, blue jay, cardinal, purple finch, indigo bunting, several species of sparrows and blackbirds, cottontail rabbit, white-tailed deer, and probably small rodents (Davison 1967, Martin et al. 1951).

The cover value of rye depends largely on the density of the stand.

g. Comments. Rye appears to have been cultivated for more than 2000 years and was the predominant world bread grain until the 19th century.

311. Genus Setaria, foxtail grass. *Setaria* is a tropical and temperate region genus of more than 140 species, thought to be related to the panic grasses. Many foxtail grasses are troublesome weeds--gregarious, persistent, and thriving under poor soil conditions. The seed head is a distinctive cylindrical structure with numerous bristles, resembling a bottlebrush or a foxtail, and giving the common name to the group. Naturally occurring in diverse habitats, from saline marshes to dry, rocky soils, the individual species may differ markedly in size. In colder areas with poor growing conditions, foxtail grass is diminutive, a few inches tall at best; in the tropics at sites with good growing conditions foxtail grasses reach 12 ft or more.

312. *Setaria italica* (L.) Beauvois, foxtail millet. (Figure 103)

a. Description and Life History. Having been selected and cultivated for several thousand years, foxtail millet is an extremely diverse species. Numerous color variations of grains, grain hulls, and bristles are known. Seed head size and density variations represent another polymorphic aspect. Foxtail millet is an annual which may be only a few inches tall to 6 ft or more. Commonly cultivated forms have yellow, red, or black grains; the seed head itself may be green, brown, or purplish at maturity. The seed hulls are even more variable, being creamy white, pale yellow, orange to reddish orange, green, purple, or mixtures of colors. The seed head shatters easily but the bristles are persistent. In addition to the intrinsic genetic controls, the seed head length and the number of seeds produced are dependent upon growing conditions. In the semiarid West the seed heads are commonly 2 to 8 in. long. Heads on plants grown in the humid East may be as long as 12 in.

b. Habitat. Full sun; escape from cultivation to roadsides, margins of fields, other open disturbed habitats.

c. Soil Requirements. Initially moist, then moist to dry, (high drought tolerance); pH 5.5 to 8.0; well-drained loam and sandy loam.

d. Establishment and Maintenance. According to Leonard and Martin (1963), foxtail millet is often sown late in fields where small grain has failed. While it can be sown directly in stubble fields; the most successful plantings are made in fields free from weeds at planting time. If the planting site is cleared and the soil surface broken, the seeds can be broadcast or drilled. Fifteen to 20 lb of seeds will be required to cover an acre by broadcast methods. If the site has not had a fertilizer applied during the previous year, the use of 200 to 300 lb per acre of 8-8-8 or 10-10-10 will increase survival and yield. Because the seeds are relatively small and would likely be eaten by birds if left on the surface, the seedbed should be rolled or packed lightly. Warm soil is required for germination. Usual planting times

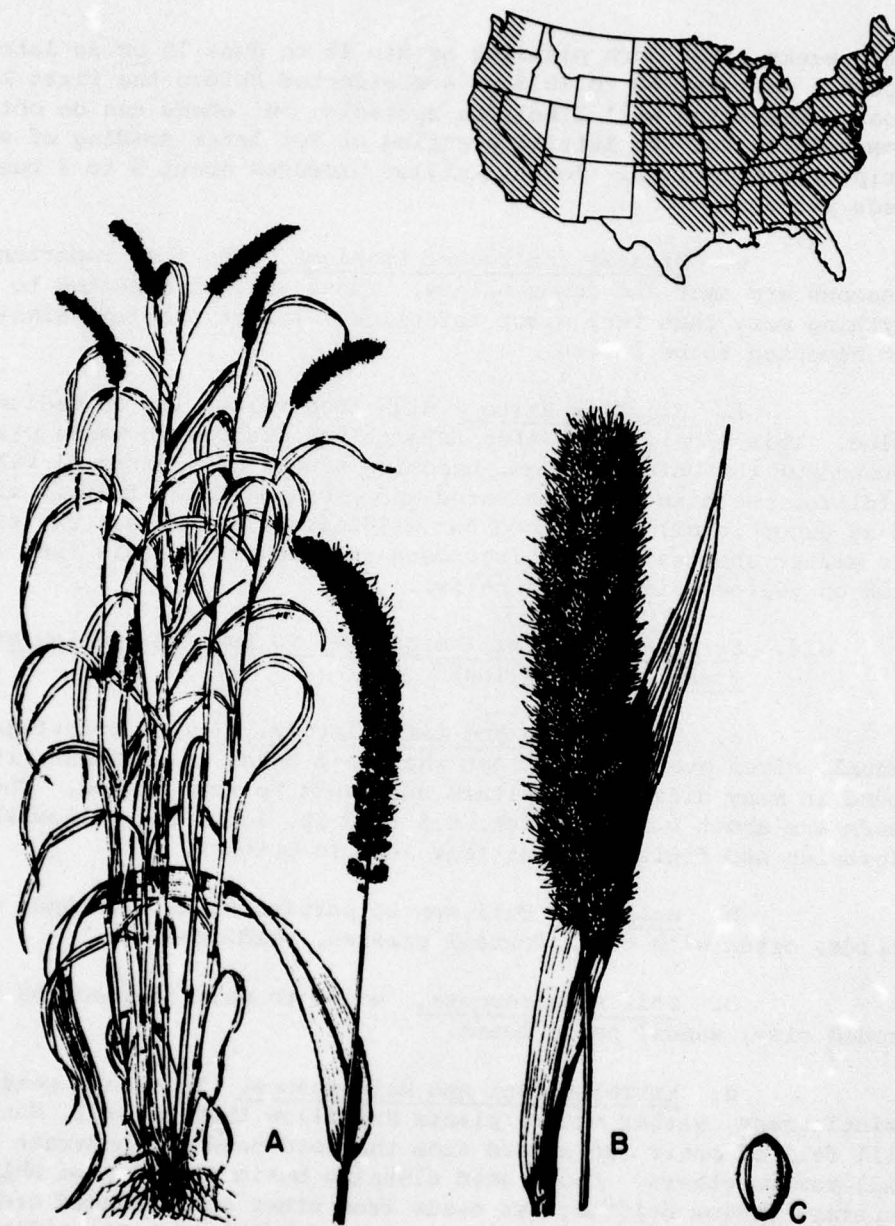


Figure 103. *Setaria italica*, foxtail millet. A, habit; B, seedhead x 1; C, floret x 5.

are 2 weeks after corn planting or May 15 to June 15 or as late as August 1 wherever 60 to 70 days are expected before the first killing frost. Reseeding will likely be sporadic, but seeds can be obtained commercially for the initial planting or for later seeding of wildlife strips if so desired. Foxtail millet produces about 5 to 7 bushels of seeds per acre.

e. Disease and Insect Problems. The most important diseases are smut and downy mildew. These are not expected to cause anything more than very minor infection. Insect problems similarly are not expected to be severe.

f. Wildlife Value. High food value; low to medium cover value. This widely cultivated *Setaria* has escaped in waste places throughout the United States, becoming a weed of additional value to wildlife. Both in the cultivated and escaped state, foxtail millet is an exceptionally good food for wildlife of all kinds, the same as its sister species *Setaria lutescens* and *Setaria viridis* (see information on yellow bristlegrass below).

313. *Setaria lutescens* (Weigel) F. T. Hubbard, yellow bristlegrass. (Figure 104)

a. Description and Life History. Yellow bristlegrass is an annual, often overlooked except when seed heads are present; it is found in many different habitats and tends to form clumps. The seed heads are about 0.5 in. thick, 0.5 to 3 in. long, and yellowish. Flowering and fruiting occur from June to October.

b. Habitat. Full sun to partial shade of crops; cultivated fields, often with other foxtail grasses, roadsides.

c. Soil Requirements. Moist to well drained; pH 5.5 to 7.3; eroded clay, sands, sandy loams.

d. Establishment and Maintenance. To obtain seeds of yellow bristlegrass, gather mature plants and allow them to dry. Many seeds will fall of their own accord from the seed head but moderate beating will remove others. Local seed cleaning businesses may be able to separate yellow bristlegrass seeds from other small seeded crops such as red clover or lespedeza that have been combined. Stratification of the seeds is not essential. They should be planted in early spring, 0.5 in. deep in a firm seedbed. Because the seeds are small, more uniform distribution can be achieved by mixing the seeds with suitable fertilizer such as 10-10-10. If row planted there should be 15 to 20 seeds per foot of row. An acre planting requires 15 to 20 lb of seeds. Yields can be improved by light cultivation of rows.

e. Disease and Insect Problems. None.

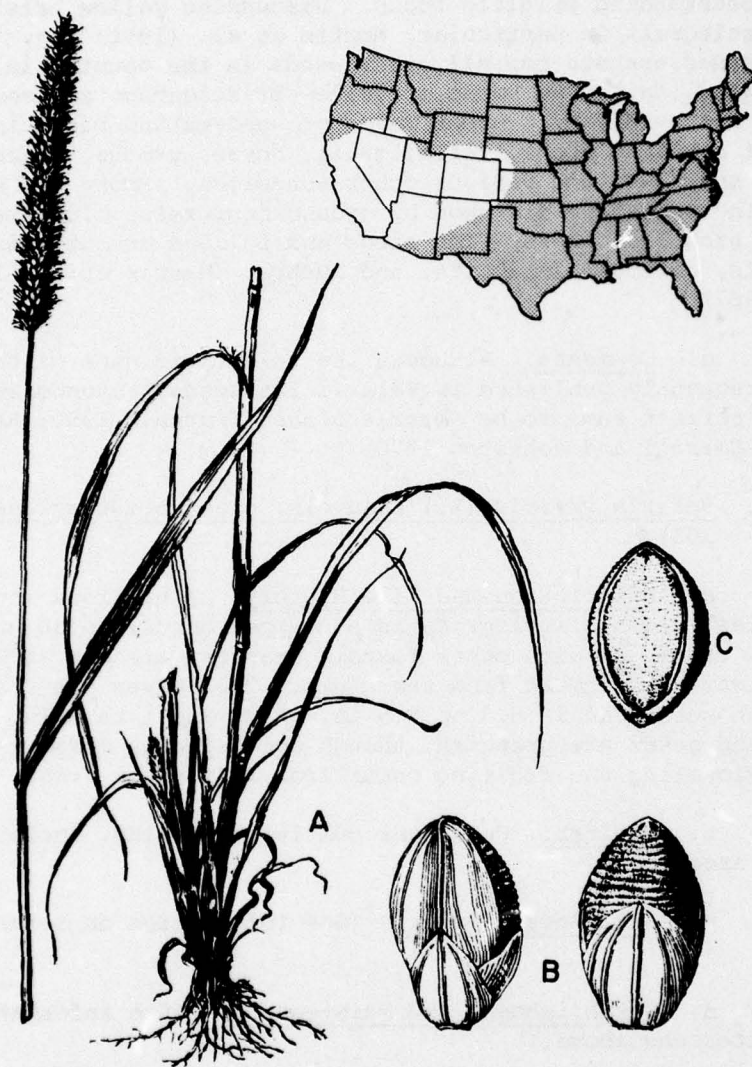


Figure 104. *Setaria lutescens*, yellow bristlegrass. A, habit x 0.5; B, two views of spikelet x 10; C, floret x 10.

f. Wildlife Value. High food value; low to medium cover value. Bristlegrasses in general, and yellow bristlegrass in particular, are outstanding wildlife foods. Discussing yellow bristlegrass and green bristlegrass in particular, Martin et al. (1951) say, "These bristly-headed grasses top all other weeds in the country in food value to wildlife." The seeds of yellow bristlegrass are consumed regularly and avidly by a great range of seed-eating birds including species of dabbling ducks, rails, quail, doves, grouse, blackbirds, grackles, sparrows, and various other songbirds. Among the small mammals, the seeds are fed upon by ground squirrels, mice, kangaroo rats, and probably others. The seeds and foliage are utilized by the jackrabbits, cottontail rabbits, and muskrat (Martin et al. 1951, Davison 1967).

g. Comments. Although the scientific name of the species that is frequently published is *Setarii lutescens*, taxonomists consider the correct name to be *Setaria glauca* (Fernald 1950; Radford et al. 1968; Correll and Johnston 1970).

314. *Setaria viridis* (L.) Beauvois, green bristlegrass. (Figure 105)

a. Description and Life History. A vigorous and aggressive species, green bristlegrass is a clumped annual to about 3 ft tall. The stems, as with other foxtail grasses, are not straight, but branch outward and upward from the clump. The leaves are mostly basal. The seed head is 0.3 to 0.5 in. thick and 1 to 3 in. long. The bristles and seeds are greenish, though occasionally mixed with purple. Flowering and fruiting occur from July until frost.

b. Habitat. Full sun; cultivated fields, roadsides, open disturbed areas.

c. Soil Requirements. (See information on *Setaria lutescens* above.)

d. Establishment and Maintenance. (See information on *Setaria lutescens* above.)

e. Disease and Insect Problems. None.

f. Wildlife Value. High food value; low to medium cover value. Green bristlegrass is possibly an even more aggressive "weed" than the yellow bristlegrass. Both species grow well and extensively in corn, grain, and clover fields and therefore will do well in planted mixtures. The use of this green bristlegrass by wildlife for food is essentially the same as for the yellow bristlegrass (see information on yellow bristlegrass, *Setaria lutescens*, above).

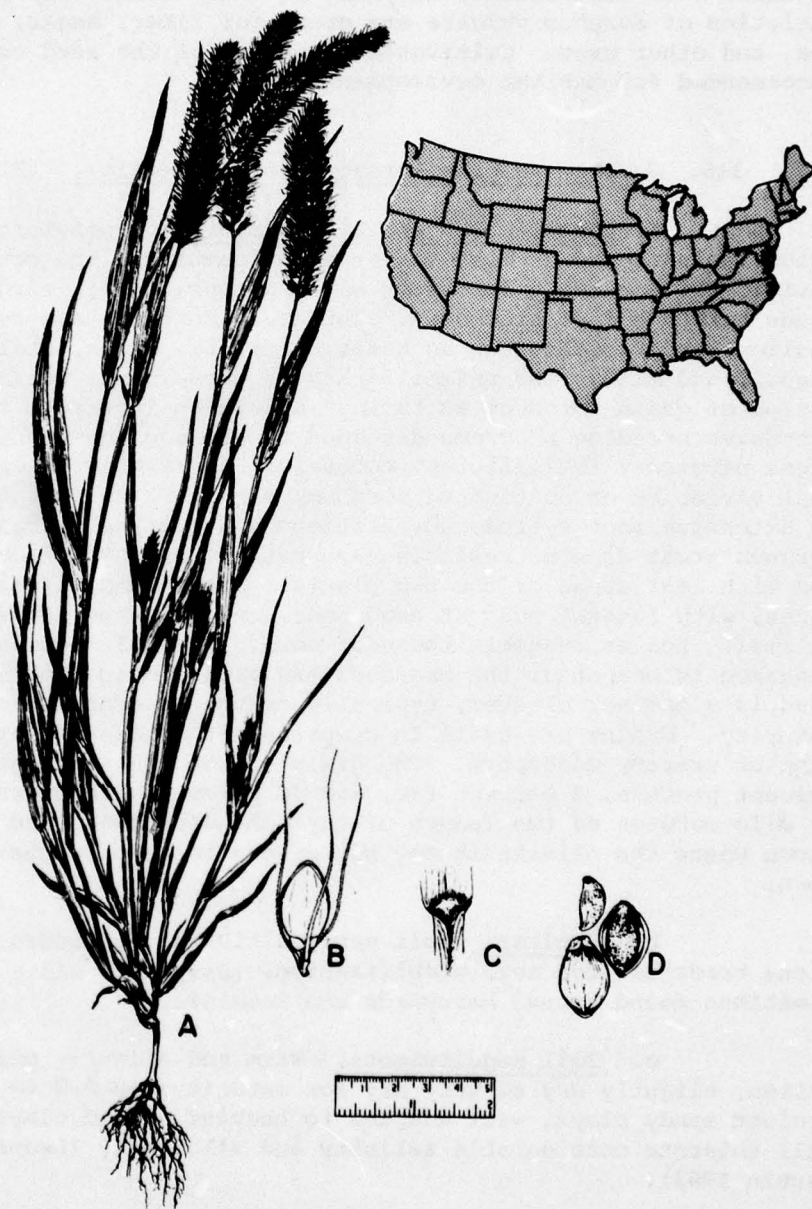


Figure 105. *Setaria viridis*, green bristlegrass. A, habit x 0.5; B, spikelet x 5; C, ligule x 1.5; D, seeds x 5.

315. Genus *Sorghum*, sorghums. The sorghums are tall grasses, native to the Old World and widely cultivated in most agricultural regions; when naturalized, they may become serious weed pests. Varieties of *Sorghum vulgare* are grown for fiber, sugar, food, seed, wax, and other uses. Cultivated varieties of the seed crop, milo, are recommended for habitat development.

316. *Sorghum vulgare* Persoon, sorghum (milo). (Figure 106)

a. Description and Life History. A polymorphic species which includes 400 or more varieties of annuals. The sorghums are divided agronomically into four major groups: grain sorghums, sorgo, grass sorghums, and broomcorn. The grain sorghums are comprised of smaller subdivisions such as kafir, feterita, durra, shallu, kaoliang, hegari, and milo. The unfamiliarity of these names warrants the designation of grain sorghums as "milo," albeit an incorrect nomenclature. Extensive breeding programs designed to produce the uniform heights of stems necessary for efficient mechanical harvesting have resulted in most varieties of cultivated sorghum reaching 3 to 4 ft in height. An extensive root system, adventitious and profusely branched, gives sorghum great drought resistance--greater than that of corn in comparison with leaf areas of the two plants. Stems commonly have about 10 nodes, with lateral buds at each node, but only the lowermost develop tillers. Leaves resemble those of corn. The self-pollinating inflorescence is branched; the branches are arranged in whorls. The seed head is a compact cluster, typically orange or orange brown at maturity. Grains are small in comparison to those of corn, but have a similar starchy endosperm. The grain on the average consists of 12 percent protein, 3 percent fat, and 70 percent carbohydrate. Sorghum or milo matures as the length of daylight decreases, and it is usually grown where the climate is too hot or dry to support the growth of corn.

b. Habitat. Full sun; cultivated in fields, planted along roadsides for soil stabilization, escaped to waste areas, and sometimes found around barnyards and feedlots.

c. Soil Requirements. Warm and slightly moist for germination, slightly dry to very dry for maturity; pH 5.0 to 7.5 medium-grained sandy clays, well adapted to heavier upland clays. Sorghum will tolerate considerable salinity and alkalinity (Leonard and Martin 1963).

d. Establishment and Maintenance. Better yields are obtained when the seedbed is prepared in fall or winter. The method of soil turnover (by plow, disk, or subsurface tilling) does not significantly affect the yield. The seeds are usually planted after the soil has warmed, generally 2 to 3 weeks after corn is planted. In the southern part of its growing region, sorghum can be planted as late as 1 September. Milo should be fertilized as needed according to soil

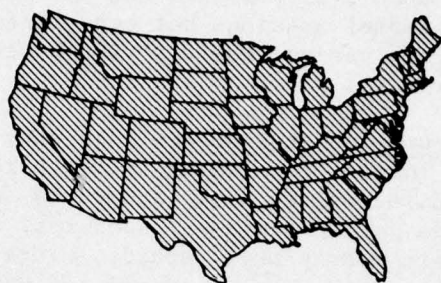


Figure 106. *Sorghum vulgare*, sorghum (milo). Grain sorghum field planting. (SCS photo)

test recommendations. The seeds can be broadcast or planted in rows. The standard width of rows is 36 to 44 in. Spacing of the grains within the rows depends upon soil moisture and the variety grown. For milo (in the strict sense) spacings between plants should be 12 to 24 in. The seeding rate varies from 2 to 10 lb per acre. The yield is 2 to 3 tons per acre.

e. Disease and Insect Problems. As with most cultivated crops, many disease and insect pests which infest sorghum have been documented. The chief diseases are smuts and rusts (which affect the seed head), root diseases, stalk diseases, seed rot, and seedling blights. Insect pests are mostly bugs, aphids, midges, borers, grasshoppers, and larval forms of insects. Leonard and Martin (1963) list approximately 35 viral, bacterial, and fungal diseases and 10 specific insect pests.

f. Wildlife Value. Medium food and cover value. Sorghum can be best used as a wildlife food patch planting where intensive wildlife management is warranted. The seeds of sorghum are a choice food of the mallard, cinnamon teal, green-winged teal, sandhill crane, ground dove, mourning dove, white-winged dove, chukar, ring-necked pheasant, prairie chicken, bobwhite, scaled quail, wild turkey, at least 20 kinds of songbirds (probably many more), and various rats and mice. White-tailed deer eat the stems and leaves as well (Martin et al. 1951, Davison 1967).

As with other cultivated grain crops, the cover value of stands of sorghum will vary according to the age and condition of the stand and to what volunteer weeds are present.

g. Comments. Sorghum contains a chemical compound which, when it breaks down, releases hydrocyanic acid (prussic acid). Losses of cattle, sheep, and goats occur each year from animals grazing on the leaves of young plants. The hydrocyanic acid content usually decreases as the plants mature; in fact, the plants are used for silage as the fodder cures and the acid content decreases to a safe level. The upper leaves, young shoots, young stalks, and tillers contain more of the compound than the seed heads. Horses and swine do not appear susceptible to the poisoning. Sorghum is considered to be unsafe for pasturage.

A commonly naturalized sorghum is Johnson grass, *Sorghum halepense*. This weed is exceptionally hardy, reproduces by root sections and by seeds, and is utilized by some wildlife species, especially the bobwhite. However the blades are sharp edged and lacerate the digestive tracts of grazing animals, particularly young livestock and rabbits. The use of this species as a possible alternative to the grain sorghums is not recommended.

317. Genus *Spartina*, cordgrass. Found predominately in wetland environments, particularly saline shores, the genus *Spartina* comprises 16 species, mostly American except for a few species that grow along the coasts of Europe and Africa. The genus is an important one in temperate areas since the cordgrasses effectuate shoreline stabilization, provide nursery grounds for finfish and shellfish, provide food and cover for terrestrial wildlife, and contribute a major portion of organic material to decomposers. With the exception of mangroves, probably no other group of plants is as critical to the maintenance of a biophysical balance in the coastal zone as the cordgrasses. Most species of *Spartina* are emergent aquatics and are able to tolerate seawater strength salinities. Certain inland species are found near salt basins or interior salt flats. Furthermore, cordgrasses usually grow rapidly, increase their population size apomictically and by dispersion of viable seeds, and succeed in some of the most infertile soils known.

318. The one species discussed below, saltmeadow cordgrass (*Spartina patens*), grows on upland sites adjacent to coastal waters as well as along the tide line and in high marsh flats. Other species may also be suited for upland development, but most are best suited for wetland habitat development and may be useful for site stabilization and erosion control along the shorelines of dredged material sites.

319. *Spartina patens* (Aiton) Muhlenberg, saltmeadow cordgrass.
(Figure 107)

a. Description and Life History. A narrow-leaved, wiry perennial found in pure or mixed stands in various shoreline habitats. Saltmeadow cordgrass occurs extensively in high marsh flats and saltmeadows, generally along saline or brackish coastal waters, and tolerates periodic inundation. It also grows frequently on dry, sandy beaches or xeric dunes above the intertidal zone. The fruiting stems commonly reach 3 to 4 ft tall, but on barrier island sands the height may be much less. The leaves are narrow, rolled inward, dull green, usually standing erect from near the base of the plant and arching near their tips. In this respect, a clump of saltmeadow cordgrass resembles a diminutive clump of the related Florida and Gulf coast species *Spartina bakeri*. The seeds are produced in a sparingly branched inflorescence, usually 3 to 5 alternating branches or spikes. The inflorescence is typically reddish purple. The spikelets are compressed with the result that the seeds are flat, about 0.2 in. long.

b. Habitat. Full sun, but persisting as a successional relic in shaded shrub thickets and maritime forests; saline and brackish marshes, marsh borders, dunes, interdune swales, transitional beach-woodland communities.

c. Soil Requirements. Wet, moist, dry to very dry; pH 6.6 to 7.3; sterile sands, sandy muck.



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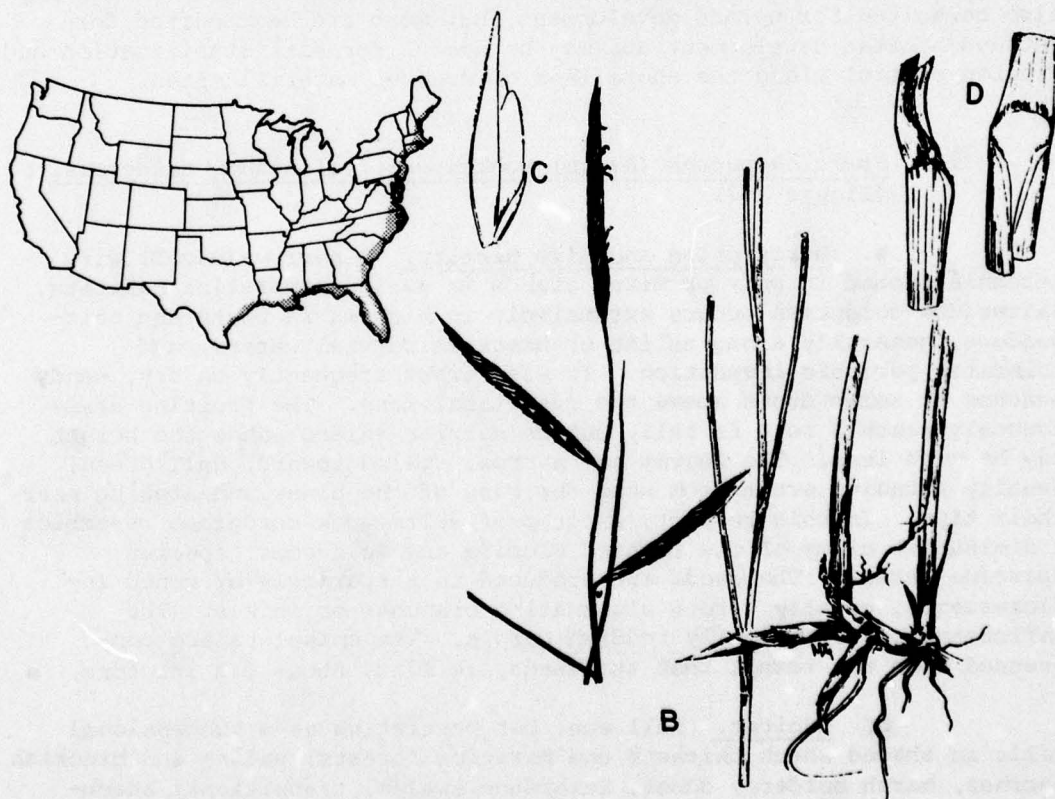


Figure 107. *Spartina patens*, saltmeadow cordgrass. A, habitat (SCS photo); B, habit; C, spikelet; D, ligule.

d. Establishment and Maintenance. Saltmeadow cordgrass seeds or sprigs can be planted. Seeds should be collected in the fall, either by hand or by improvised harvesting machine. The seeds should be stored under cold conditions. Unstratified or 1-month stratified seeds can then be planted in the spring. Planting in rows is preferable to broadcast methods. The rows need to be 2 to 4 ft apart, with 16 to 20 seeds per foot, and the seeds covered to a depth of 0.5 to 0.75 in. If the planting site is within the range of salt spray, near the mouth of an inlet, for example, inorganic nutrients will be derived from the spray. If the site is not within the salt spray zone, fertilizers will have to be applied. Graetz (1973) recommends for beach sand plantings 30-10-0 fertilizer with 10-10-10, 8-8-8, or 16-8-8 as acceptable alternatives; fertilizer rates are 3 lb per 1000 sq ft for 30-10-0 (12 lb for 8-8-8) applied quarterly beginning in March and omitting December. Sprigs can be obtained by first growing the plants from seeds and simply transplanting, or by exhuming planting stock from thick patches around marshes. A large clump will supply several stock sections each composed of culm or stem and attached roots.

e. Disease and Insect Problems. None.

f. Wildlife Value. Low food value; high cover value. Wildlife species known to eat either seeds, rootstalks, stems, or sprouts of the saltmeadow cordgrass include the American brant, blue goose, snow goose, Canada goose, black duck, mallard, green-winged teal, whooping crane, clapper rail, Virginia rail, sora, seaside sparrow, sharp-tailed sparrow, muskrat, nutria, and white-tailed deer (Martin and Uhler 1951, Martin et al. 1951, Davison 1967, Milne 1963).

Saltmeadow cordgrass is of the greatest importance as a wildlife cover plant on coastal dredged material and in the maritime herbaceous communities from the tidal drift line to the tops of the lower dunes (Davis 1957, Martin et al. 1951, Oosting 1954, Quay 1959, Milne 1963, Soots and Parnell 1975b). Saltmeadow cordgrass provides essential protective cover (feeding, resting, and/or nesting) for a wide variety of coastal dune and swale, vegetated tidal flat, and tidal drift line species of wildlife, including geese, some ducks, sandpipers, plovers, terns, gulls, skimmers, rails, seaside sparrows, sharp-tailed sparrows, long-legged wading birds, and even migrating hawks, owls, and songbirds.

320. Genus *Triticum*, wheat. Wheat, thought to be one of the earliest cereals brought into cultivation, comprises approximately a dozen species, each with numerous varieties. The dredged material site conditions will dictate the best variety to use for wildlife plantings; the advice and experience of local agricultural experts should be followed. There are both spring and winter wheats. *Triticum aestivum*, discussed below, is the primary species grown, especially in the East. Wheat is one of the plants most widely used by wildlife.

321. *Triticum aestivum* L., wheat. (Figure 108)

a. Description and Life History. Wheat is the world's most widely cultivated crop and comprises several cultivars which evidently were derived from wild plants of southwestern Asia at least 5000 years ago. *Triticum aestivum* is common bread wheat, a hexaploid of presumably hybrid origin and unknown as a wild plant anywhere in the world. It is an annual with fruiting stems reaching 3 ft and topped by a bristly compact head. The stems and leaves are smooth. The mature orange or brownish-orange grain is grooved, oblong, somewhat blunt at the ends, and 0.25 to 0.3 in. long. There are winter and spring varieties. The winter variety is planted in the fall and young plants usually emerge and form dense basal tufts before the onset of severe cold weather. The yellowish-green young leaves are lighter in color than those of oats. In spring, growth is rapid and the heads emerge in early May (mid-Atlantic states) with the seeds ripening in late May or June.

b. Habitat. Full sun; cultivated fields, roadsides, barnyards, feedlots, along railroads, waste areas.

c. Soil Requirements. Moist for germination followed by moist to dry; grows well in regions with 30 in. of annual precipitation; pH 6.0 to 7.5; loams, clay-loams, clays, humus-rich sands.

d. Establishment and Maintenance. Plowing in spring (arid regions) or midsummer (humid regions) prepares the seedbed for wheat. Soil moisture is an important factor for wheat, and removing weeds and other cover plants is advantageous to conserving water and reducing the amount of soil nutrients that are accumulated in leaves and stems of other plants. For certain midwestern areas, planting in a stubble mulch may further conserve moisture. With two major kinds of wheat available for planting, winter and spring varieties, the planting season usually ranges from August through October; advice of local agricultural experts should be followed. The optimum date of seeding winter wheat varieties occurs when the mean daily temperature lies between 50° and 60°F. Rate of seeding in the eastern U. S. is 1.3 to 2 bushels per acre. The rate of seeding is slightly higher for spring wheat than for winter wheat. Rate of seeding in the western U. S. is 1 to 1.5 bushes per acre. The usual rule is that the lower the annual



Figure 108. *Triticum aestivum*, wheat. A, habit x 0.5; B, awned and nearly awnless spikes x 0.5; C, spikelet x 3; D, floret x 3.

precipitation, the lower the rate of seed sown. Seeds can be drilled or broadcast, depending on which is most cost effective.

Fertilization programs should conform with soil analyses and recommendations by local agronomists. In most areas nitrogen will be needed. Application of phosphate and potash may be necessary in soils deficient in these minerals.

e. Disease and Insect Problems. Several diseases and insect pests attack wheat, a problem that is intensified by the millions of acres planted. Fungal rusts are the most serious diseases. Stem rust deprives the plant of water and nutrient materials, causes asynchronous ripening of the grains, and accelerates metabolic processes. Leaf rust occurs in humid areas and ultimately results in drastic reduction of the seed crop. Wheat smuts also cause a reduction in yield. Powdery mildew may cause extensive damage in cool, moist climates. Mosaic viruses and several stem, leaf, and root rot diseases also attack wheat. Among the many insects which infest wheat are Hessian fly, jointworm, wheat straw-worm, grasshoppers, Mormon crickets, wireworms, chinch bugs, cutworms, billbugs, and armyworms. Control of these pests is accomplished by removing associated weeds, plant rotation, and application of chemicals. For dredged material habitats, the possibility of epidemic grain diseases is remote and should not be a major deterrent to selecting this extremely valuable cereal for habitat development.

f. Wildlife Value. High food value, low to medium cover value. Wheat rivals corn as a top food for wildlife. It is, "... one of the most valuable wildlife plants in the whole country. The source of man's 'staff of life' is also the mainstay for wild creatures" (Martin et al. 1951). Wheat for wildlife is available at all seasons, there being both winter and spring wheats and a number of varieties. The kernels are the main food, but seedlings, young plants, and foliage also are eaten by some waterfowl, fur and game mammals, small mammals, and deer. Martin et al. (1951) and Davison (1967) both identify approximately 100 species of users. Generally, the animals that eat corn also eat wheat.

Wheat, along with corn and other cereal grains, present a variety of wildlife cover, according to stand and conditions. The stubble fields develop rich crops of volunteer ragweed and other weeds, thus providing a further source of food and cover. Wheat would best be used as a wildlife food planting where intensive management efforts are warranted and can be accomplished.

322. Genus Zea, corn. Corn is the most important cereal grain grown in the United States. The genus Zea contains only one species, but this single species occurs in several different forms. The commercially grown varieties include flour, flint, waxy, dent, sweet corns, and popcorn.

323. Corn is one of the leading wildlife foods in the country and has potential for wildlife food plantings on dredged material sites if the prerequisite growing conditions are met. There are many varieties and hybrids which are adapted to various soil and climatic conditions; local agricultural experts can suggest the best varieties for use in particular areas and under known environmental conditions.

324. Zea mays L., corn. (Figure 109)

a. Description and Life History. Robust, yellowish-green nonreseeding annual with stems generally ranging from 5 to 15 ft tall, terminating in a branched inflorescence of male flowers. The female flowers are borne laterally about midway up the stalk, the inflorescence surrounded by tightly adhering bracts (husks) with protruding styles (silk). Corn is presumed to be a New World crop, probably originating in northern South America and cultivated northward into Central America, especially Mexico, where it became the established staple prior to Spanish exploration. At the time of European colonization in the Americas, corn was cultivated from Chile to the St. Lawrence valley (Baker 1965). The leaves, about 2 in. wide with a prominent midrib, are arching-flexuous, and during droughts tend to curl inward from the margins. Adventitious prop roots form at the lower stem nodes; the prop roots are often reddish in appearance and aid in keeping the plant erect. When planted in early April, corn begins to flower in late May or June and the seeds ripen by September. Seeds are arranged in rows on the ear and may be yellow, white, red, or mixed colors. They are typically indented at the distal ends on the varieties grown for animal feed. The seeds are wedge shaped, about as long as or slightly longer than wide and about one-third as thick.

b. Habitat. Full sun; cultivated fields, roadsides, pastures, feedlots, and waste areas.

c. Soil Requirements. Moist; pH 5.2 to 7.5; fertile sandy loams to clays.

d. Establishment and Maintenance. Corn should be planted on suitable dredged material only when intensive management of wildlife food plantings is warranted. Row planting is the standard method for growing corn as a crop. Rows are spaced about 30 in. apart and the plants usually spaced 2 to 10 in. apart in the rows, depending on such factors as the soil characteristics, corn variety, and expected growing season precipitation. (In Mexico, corn is sometimes planted in widely spaced "hills.") The recommended fertilization programs involves

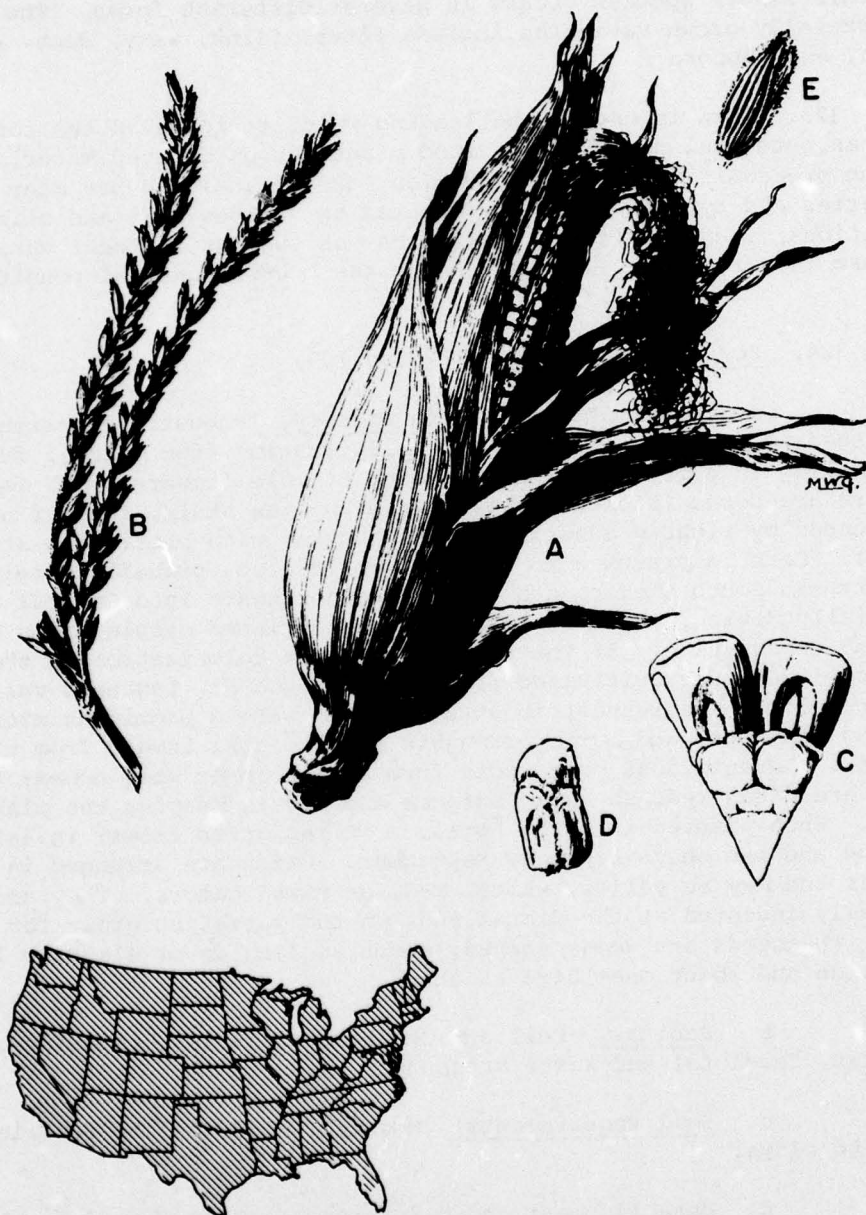


Figure 109. *Zea mays*, corn. A, pistillate inflorescence (ear) x 0.5; B, two branches of staminate inflorescence (tassel) x 0.5; C, mature grains x 2; D, single pistillate spikelet soon after flowering x 4; E, staminate spikelet x 2.

preplant application of 50 percent of the nitrogen requirement plus all the potassium and phosphorus indicated by soil tests. The remainder of the nitrogen should be applied as a top-dressing (e.g., liquid nitrogen, ammonia, urea) when the plants are 8 to 12 in. tall. Nitrogen is required to bring the crop to maturity. Maturation can be accelerated by application of magnesium to the soil.

For wildlife habitat development corn can be planted randomly; however, in a combination with other food and cover crops, it is best to plant the corn in rows with the other crops broadcast between the rows. Corn is reputed to be one of the most nutrient-demanding crops grown; therefore continual yearly replantings will require increased amounts of fertilizer.

Wildlife consume corn from the time the seed is planted until the plants die and the seeds completely deteriorate. It may be necessary to chemically treat the seeds prior to planting to prevent degradation by birds and small mammals prior to germination. Some wildlife use of the plants prior to maturity of the ears is to be expected. For example, deer may browse the plants or raccoons may feed on the milky stage of the ears. If mature ears are desired (for waterfowl food, etc.), then the stand should be located in an area less accessible to other wildlife or the amount planted should be large enough to compensate for consumption by all potential users.

e. Disease and Insect Problems. Corn is susceptible to several diseases and insect problems. Corn smut, a fungus which attacks the ear, usually envelops the upper portion of the young fruits, forming grossly misshapened outgrowths which are filled with minute black spores at maturity. The corn borer infests the cob resulting in premature disarticulation of the ear from the stalk. The grains are subject to attack by weevils and care must be taken with storage to prevent these insects from destroying the embryo. Other damage and loss to commercial production is attributed to invasion of fields by blackbirds which peck through the husks, either in search of insects or for the kernels. In addition to the waste by shattering, the husk damage permits rainwater to be trapped inside, thus facilitating decay.

f. Wildlife Value. High food value; low to medium cover value. Corn is an outstanding wildlife food in all the eastern and central states, especially in fall and winter. The known list of birds which feed on corn kernels whenever and wherever available is almost too long to enumerate (over 100), but includes ducks, geese, swans, marshbirds, shorebirds, sandhill and whooping cranes, doves, grouse, pheasants, quail, wild turkeys, blackbirds, woodpeckers, crows, sparrows, finches, buntings, titmice, thrashers, and starlings. Mammals which feed on the kernels, stems, or foliage of corn are beaver, foxes, muskrat, opossum, cottontail rabbits, raccoon, skunks, fox and gray squirrels, chipmunks, gophers, ground squirrels, moles, wild mice, deer, and elk (Martin et al. 1951, Yelverton and Quay 1959, Davison 1967).

The cover value varies according to the condition or state of the stand. The mature, unharvested crop provides the greatest cover. The older but still unharvested fields with some plants and ears falling to the ground also provide good cover and increased food availability. Stubble fields provide little cover but usually contain much grain (especially if machine-cut) and also seeds of crabgrass, ragweed, and other weeds which grow beneath the corn. It is common practice in wildlife management to plant food patches of corn and other cultivated grains adjacent to other cover.

LIST OF CREDITS

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Organizations

Coastal Zone Resources Division of Ocean Data Systems, Inc., Wilmington, North Carolina.

Figures 10, 13, 15A, 16, 19, 20, 23, 26, 30, 31, 34, 37, 38, 39, 41, 42, 44, 45, 53, 55, 61, 63, 67, 80, 95A, 97A.

North Carolina Wildlife Resources Commission, Raleigh, North Carolina.
Figures 64, 94.

United States Department of Agriculture, Soil Conservation Service.

Figures 1, 2, 3, 4, 5, 6, 7, 8, 9, 14, 15B, 18, 21, 22, 27, 28, 32, 47, 48, 52, 54, 78A, 84, 86, 90, 91, 93, 106, 107A.

Publications

Beal 1977. Figure 85.

California Department of Fish and Game 1968. Figure 17.

Halls and Ripley 1961. Figures 11, 24, 43, 49, 50, 51.

Hitchcock 1950. Figures 78(B, C, D), 79, 83, 87, 88, 89, 95(B, C, D), 96, 97(B, C, D), 102, 103(B, C), 104, 108, 109.

Illinois Agricultural Experiment Station 1960. Figure 65.

Leithead et al. 1971. Figures 99, 107(B, C, D).

USDA 1948. Figures 98, 100, 101, 103A.

USDA, Agricultural Research Service 1970. Figures 29, 33, 35, 36, 46, 56, 57, 58, 59, 60, 62, 69, 70, 71, 72, 73, 81, 82, 92, 105.

Viereck and Little 1974. Figures 12, 40.

Wilbur 1963. Figures 25, 66, 68, 74, 75, 76, 77.

LITERATURE CITED

- Allan, P. F., and W. W. Steiner. 1972. Autumn olive for wildlife and other conservation uses. U. S. Dep. Agr. Leaflet 458. 8 pp.
- Allen, D. A., ed. 1956. Pheasants in North America. The Stackpole Co., Harrisburg, Pa., and The Wildlife Management Institute, Washington, D. C. 490 pp.
- American Ornithologists' Union. 1957. Check-list of North American birds, 5th ed. Port City Press, Baltimore. 691 pp.
- American Ornithologists' Union. 1973. Thirty-second supplement to the American Ornithologists' Union check-list of North American birds. Auk 90(2):411-419.
- American Ornithologists' Union. 1976. Thirty-third supplement to the American Ornithologists' Union check-list of North American birds. Auk 93:875-879.
- Asplundh Environmental Services. 1977. Management of transmission line rights-of-way for fish and wildlife for evaluation purposes. (partial draft), U. S. Dep. of Interior, Office of Biological Services, Ann Arbor, Mich. [Final report will be available in January 1979].
- Bailey, R. W., and K. T. Rinell. 1968. History and management of the wild turkey in West Virginia. West Virginia Dep. of Nat. Resour., Div. of Game and Fish Bull. 6. 59 pp.
- Bailey, V. L., and H. E. Bailey. 1949. Woody plants of the western national parks. Am. Midl. Nat. Monogr. 4. The University Press, Notre Dame, Ind. 274 pp.
- Baker, H. G. 1965. Plants and civilization. Wadsworth Publishing Co., Belmont, Calif. 183 pp.
- Barnes, D. 1971. Anatomy of a spoil island. M. S. Thesis. Texas A & I University, Kingsville, Tex. 70 pp.
- Baxter, W. L., and C. W. Wolfe. 1973. Life history and ecology of the ring-necked pheasant in Nebraska. Nebraska Game and Parks Comm., Lincoln, Neb. 58 pp.
- Beal, E. O. 1977. A manual of marsh and aquatic vascular plants of North Carolina with habitat data. Tech. Bull. 247. North Carolina Agri. Exp. Sta., Raleigh, N.C. 298 pp.

- Beaman, B. 1973a. Patterns of plant community structure and vegetational zones on spoil islands in Sarasota Bay and Charlotte Harbor, Florida. Div. of Nat. Sci., New College, Sarasota, Fla. 69 pp. Mimeo.
- Beaman, B. 1973b. Patterns of succession on spoil islands: vegetation. Div. of Nat. Sci., New College, Sarasota, Fla. 90 pp. Mimeo.
- Bellrose, F. C. 1976. Ducks, geese and swans of North America. Stackpole Books, Harrisburg, Pa. 543 pp.
- Bent, A. C. 1919. Life histories of North American diving birds. U. S. Natl. Mus. Bull. 107. xiii + 239 pp.
- Bent, A. C. 1921. Life histories of North American gulls and terns. U. S. Natl. Mus. Bull. 113 x + 337 pp.
- Bent, A. C. 1922. Life histories of North American petrels and pelicans and their allies. U. S. Natl. Mus. Bull. 121. xiv + 335 pp.
- Bent, A. C. 1923. Life histories of North American wild fowl. Part 1. U. S. Natl. Mus. Bull. 126. 246 pp.
- Bent, A. C. 1925. Life histories of North American wild fowl. Part 2. U. S. Natl. Mus. Bull. 130. vi + 314 pp.
- Bent, A. C. 1926. Life histories of North American marsh birds. U. S. Natl. Mus. Bull. 135. xii + 392 pp.
- Bent, A. C. 1927. Life histories of North American shore birds. Part 1. U. S. Natl. Mus. Bull. 142. 359 pp.
- Bent, A. C. 1929. Life histories of North American shore birds. Part 2. U. S. Natl. Mus. Bull. 146. 340 pp.
- Bent, A. C. 1932. Life histories of North American gallinaceous birds. U. S. Natl. Mus. Bull. 162. xi + 490 pp.
- Bent, A. C. 1937. Life histories of North American birds of prey. Part 1. U. S. Natl. Mus. Bull. 167. 409 pp.
- Bent, A. C. 1938. Life histories of North American birds of prey. Part 2. U. S. Natl. Mus. Bull. 170. 490 pp.
- Bent, A. C. 1939. Life histories of North American woodpeckers. U. S. Natl. Mus. Bull. 174. xii + 334 pp.
- Bent, A. C. 1940. Life histories of North American cuckoos, goat-suckers, hummingbirds, and their allies. U. S. Natl. Mus. Bull. 176. viii + 506 pp.

- Bent, A. C. 1942. Life histories of North American flycatchers, larks, swallows, and their allies. U. S. Natl. Mus. Bull. 179. 555 pp.
- Bent, A. C. 1946. Life histories of North American jays, crows, and titmice. U. S. Natl. Mus. Bull. 191. ix + 495 pp.
- Bent, A. C. 1948. Life histories of North American nuthatches, wrens, thrashers, and their allies. U. S. Natl. Mus. Bull. 195. x + 475 pp.
- Bent, A. C. 1949. Life histories of North American thrushes, kinglets, and their allies. U. S. Natl. Mus. Bull. 196. viii + 452 pp.
- Bent, A. C. 1950. Life histories of North American wagtails, shrikes, vireos, and their allies. U. S. Natl. Mus. Bull. 197. vii + 411 pp.
- Bent, A. C. 1958. Life histories of North American blackbirds, orioles, tanagers, and allies. U. S. Natl. Mus. Bull. 211. viii + 549 pp.
- Bent, A. C. 1968. Life histories of North American cardinals, grosbeaks, buntings, towhees, finches, sparrows, and allies. Parts 1, 2, and 3. Compiled and edited by O. L. Austin, Jr., U. S. Natl. Mus. Bull. 237. 1889 pp.
- (Dover reprints of the entire series by Bent are available.)
- Borrell, A. E. 1971. Russian - olive for wildlife and other conservation uses. U. S. Dep. Agr. Leaflet 517. 8 pp.
- Brown, R. L., and A. L. Hafenrichter. 1962. Stabilizing sand dunes on the Pacific coast. U. S. Dep. Agr. Soil Conserv. Serv. Misc. Publ. 892. 18 pp.
- Buckley, P. A., and F. G. Buckley. 1975. The significance of dredge spoil islands to colony nesting waterbirds in certain national parks. Pages 34-45 in J. F. Parnell and R. F. Soots, Jr., eds. Proceedings of a conference on management of dredge islands in North Carolina estuaries. UNC Sea Grant Program Publ. UNC-SG-75-01.
- Buckley, F. G., and C. A. McCaffrey. 1978. A study of the use of dredged material islands by colonial seabirds and wading birds in New Jersey. Technical Report in preparation. U. S. Army Engineer Waterways Exp. Sta., Vicksburg, Miss.
- Bull, J., and J. Farrand, Jr. 1977. The Audubon Society field guide to North American birds: eastern region. Alfred A. Knopf, New York. 776 pp.

- Burt, W. H., and R. P. Grossenheider. 1964. A field guide to the mammals. Houghton-Mifflin Co., Boston, Mass. 284 pp.
- California Department of Fish and Game. 1968. Atriplex: A cover plant for wildlife. Game Manage. Leaflet 11. 11 pp.
- Campbell, W. V. 1972. Investigation of insects affecting vegetation used in coastal dune and dredge spoil stabilization. Pages 25-26 in University of North Carolina Sea Grant Program Publ. UNC-SG-72-01.
- Carlson, P. R. [1973?]. Patterns of succession on spoil islands. Div. of Nat. Sci., New College, Sarasota, Fla. 114 pp. Mimeo.
- Chaney, A. H., B. R. Chapman, J. P. Karges, D. A. Nelson, R. R. Schmidt, and L. C. Thebeau. 1978. The use of dredged material islands by colonial seabirds and wading birds in Texas. Technical Report D-78-8. U. S. Army Engineer Waterways Experiment Station Vicksburg, Miss.
- Coastal Zone Resources Corporation. 1977. A comprehensive study of successional patterns of plants and animals at upland disposal areas. U. S. Army Engineer Waterways Exp. Sta. Contract Report D-77-2. Vicksburg, Miss. 395 pp. + Appendix.
- Cochran, D. M., and J. G. Goin. 1970. The new field book of reptiles and amphibians. G. P. Putnam's Sons, New York. 359 pp.
- Conant, R. 1975. A field guide to reptiles and amphibians of eastern and central North America. Houghton-Mifflin Co., Boston, Mass. 429 pp.
- Correll, D. S., and M. C. Johnston. 1970. Manual of the vascular plants of Texas. Texas Research Foundation, Renner, Tex. 1881 pp.
- Crawford, H. S., Jr. 1961 *Juniperus virginiana*, eastern redcedar. Pages 34-35 in L. K. Halls and T. H. Ripley, eds. Deer browse plants of southern forests. U. S. Dep. Agr. Forest Serv. South. and Southeast. Forest Exp. Stas.
- Cummings, E. G., and T. L. Quay. 1953. Food habits of the mourning dove in North Carolina. J. Elisha Mitchell Sci. Soc. 69(2):142-149.
- Custer, T. W., and R. G. Osborn. 1977. Wading birds as biological indicators: 1975 colony survey. U. S. Dep. of Interior, Fish and Wildl. Serv. Special Sci. Report - Wildl. 206. 28 pp.
- Dabydeen, S., and R. G. Koch. 1977. Vegetation and floristics of a sand spoil deposit - Barker's Island in Superior Harbor, Douglas County, Wisconsin. Mich. Bot. 16(1):39-46.

- Dahlberg, B. L., and R. C. Guettinger 1956. The white-tailed deer in Wisconsin. Wisconsin Conserv. Dep. Tech. Wildl. Bull 14. 282 pp.
- Dale, E. E., Jr. 1961. Vaccinium spp., blueberries. Pages 70-73 in L. K. Halls and T. H. Ripley, eds. Deer browse plants of southern forests. U. S. Dep. Agr. Forest Serv. South. and Southeast. Forest Exp. Stas.
- Dames and Moore. 1977. Review of dredged material disposal techniques to identify wildlife habitat development factors. U. S. Army Engineer Waterways Exp. Sta. Misc. Paper D-77-5. Vicksburg, Miss.
- Dasmann, W. 1971. If deer are to survive. Stackpole Books, Harrisburg, Pa., and The Wildlife Management Institute, Washington, D. C.
- Dasmann, W. P. 1975. Big game of California. California Dep. Fish and Game, Sacramento, Calif. 58 pp.
- Davis, J. H. 1957. Dune formation and stabilization by vegetation and plantings. U. S. Army Corps of Engineers Tech. Memo. 101. 47 pp. + Appendix.
- Davis, J. R. 1976. Management of Alabama wild turkeys. Alabama Dept. Conserv. and Nat. Resour. Game and Fish Div. Spec. Rep. 5. 53 pp.
- Davis, W. B. 1966. The mammals of Texas. Texas Parks and Wildl. Dep., Austin, Tex. 267 pp.
- Davison, V. E. 1967. Attracting birds: from the prairies to the Atlantic. Thomas Y. Crowell Co., New York. 252 pp.
- Davison, V. E., and K. E. Graetz. 1957. Managing farm, ranch, and woodland for deer and wild turkeys in the Gulf states and the Southeast. U. S. Dep. Agr. Soil Conserv. Serv. n.p. Mimeo.
- Doran, W. L. 1937. Propagation of woody plants by cuttings. Massachusetts Agr. Exp. Sta. Bull. 491.
- Duncan, W. H. 1975. Woody vines of the southeastern United States. University of Georgia Press, Athens, Ga. 76 pp.
- Emery, D. 1964. Seed propagation of native California plants. Santa Barbara Botanic Garden Leaflet 1(10):81-96.
- Evans, J. 1970. About nutria and their control. U. S. Dep. of Interior, Fish and Wildl. Serv. Resour. Publ. 86. 65 pp.

- Ferguson, E. R., and E. R. Lawson. 1974. Eastern redcedar, an American wood. U. S. Dep. Agr. Forest Serv. FS-260. 6 pp.
- Fernald, M. L. 1950. Gray's manual of botany. American Book Co., New York. lxiv + 1632 pp.
- Fowells, H. A. 1965. Silvics of forest trees of the United States. U. S. Dep. Agr. Handbook 271. 762 pp.
- Gabrielson, I. N., and S. G. Jewett. 1940. Birds of Oregon. Oregon State College, Corvallis, Ore. 650 pp. [Reprinted in 1970 by Dover Publications, New York with new title, Birds of the Pacific Northwest.]
- Giles, R. H., Jr., ed. 1969. Wildlife management techniques. The Wildlife Society, Washington, D. C. 633 pp.
- Gill, J. D., and W. M. Healy. 1974. Shrubs and vines for north-eastern wildlife. U. S. Dep. Agr. Forest Serv. Gen. Tech. Report NE-9. 180 pp.
- Goodrum, P. D. 1961. Smilax spp., greenbriers. Pages 62-67 in L. K. Halls and T. H. Ripley, eds. Deer browse plants of southern forests. U. S. Dep. Agr. Forest Serv. South. and Southeast. Forest Exp. Stas.
- Graetz, K. E. 1973. Seacoast plants of the Carolinas for conservation and beautification. U. S. Dep. Agr. Soil Conserv. Serv., Raleigh, N. C. 206 pp.
- Graham, E. H. 1941. Legumes for erosion control and wildlife. U. S. Dep. Agr. Misc. Publ. 412. 153 pp.
- Grant, J. A., and C. L. Grant. 1967. Trees and shrubs for Pacific northwest gardens. University of Washington Press, Seattle, Wash. 335 pp.
- Grimm, W. C. 1966. Recognizing native shrubs. Stackpole Co., Harrisburg, Pa. 319 pp.
- Hall, E. R., and K. R. Kelson. 1959. The mammals of North America. 2 Volumes. Ronald Press, New York. 1083 pp.
- Halls, L. K., and P. D. Goodrum. 1961. Lonicera japonica Thunb., Japanese honeysuckle. Pages 38-39 in L. K. Halls and T. H. Ripley, eds. Deer browse plants of southern forests. U. S. Dep. Agr. Forest Serv. South. and Southeast. Forest Exp. Stas.
- Halls, L. K. and T. H. Ripley, eds. 1961. Deer browse plants of southern forests. U. S. Dep. Agr. Forest Serv. South. and Southeast. Forest Exp. Stas. 78 pp.

- Halvorson, W. L., and C. G. Dawson. 1973. Coastal vegetation. Pages 9.1-9.92 in University of Rhode Island Marine Experiment Station, Coastal and offshore environmental inventory Cape Hatteras to Nantucket shoals complement volume. Marine Publ. Ser. 3. University of Rhode Island, Kingston.
- Hartmann, H. T., and D. E. Kester. 1968. Plant propagation principles and practices, 2nd ed. Prentice-Hall, Englewood Cliffs, N. J. 702 pp.
- Hewitt, O. H. 1967. The wild turkey and its management. The Wildlife Society, Washington, D. C. 589 pp.
- Hitchcock, A. S. 1950. Manual of the grasses of the United States, 2nd ed. Revised by A. Chase. U. S. Dep. Agr. Misc. Publ. 200. 2 volumes. 1051 pp.
- Hitchcock, C. L., and A. Cronquist. 1973. Flora of the Pacific northwest. University of Washington Press, Seattle, Wash. 730 pp.
- Holm, L. G., D. L. Plucknett, J. V. Pancho, and J. P. Herberger. 1977. The world's worst weeds. University of Hawaii Press, Honolulu, Hi. 609 pp.
- Hunt, L. J. 1976. Upland habitat development on dredged material. Pages 511-524 in Dredging: environmental effects and technology, Proc. World Dredging Conference VII. WODCON Assn., San Pedro, Calif.
- Illinois Agricultural Experiment Station. 1960. Weeds of the north central states. Illinois Agr. Exp. Sta. Circular 718. 262 pp.
- Ingles, L. G. 1965. Mammals of the Pacific states. Stanford University Press, Stanford, Calif. 506 pp.
- Iowa Department of Soil Conservation, Land Rehabilitation Advisory Board. [1973?]. Recommendations for establishment of vegetation on surface mined areas. 13 pp.
- Johnsgard, P. A. 1973. Grouse and quails of North America. University of Nebraska Press, Lincoln. 553 pp.
- Johnsgard, P. A. 1975. Waterfowl of North America. Indiana University Press, Bloomington, Ind. 575 pp.
- Jones, J. K., Jr., D. C. Carter, and H. H. Genoways. 1975. Revised checklist of North American mammals north of Mexico. Occasional Papers of Mus. of Texas Tech University 28:1-14.

- Kortright, F. H. 1967. Ducks, geese and swans of North America. The Stackpole Co., Harrisburg, Pa. 476 pp.
- Kozlik, F. M. 1974. Waterfowl of California. California Dep. Fish and Game, Sacramento, Calif. 39 pp.
- Kurz, H., and R. K. Godfrey. 1976. Trees of northern Florida. Omni Press, Sarasota, Fla. 311 pp.
- Landin, M. C. 1978a. Wading birds and wetlands management in Proc. 3rd Annu. Non-game Symposium, January, 1978. Atlanta, Ga. In Press.
- Landin, M. C. 1978b. National perspective of sea and wading bird nesting on dredged material islands in Trans. N. Am. Wildl. Nat. Resour. Conf. 43: In Press.
- Landin, M. C., and R. F. Soots, Jr. 1977. Colonial bird use of dredged material islands: a national perspective in Proc. 2nd Annu. Colonial Waterbird Conference, DeKalb, Ill.
- Lay, D. W. 1961a. Callicarpa americana L., American beautyberry. Pages 4-5 in L. K. Halls and T. H. Ripley, eds. Deer browse plants of southern forests. U. S. Dep. Agr. Forest Serv. South. and Southeast Forest Exp. Stas.
- Lay, D. W. 1961b. Ilex vomitoria Ait., yaupon. Pages 28-29 in L. K. Halls and T. H. Ripley, eds. Deer browse plants of southern forests. U. S. Dep. Agr. Forest Serv. South. and Southeast. Forest Exp. Stas.
- Leithead, H. L., L. L. Yarlett, and T. N. Shiflet. 1971. 100 native forage grasses in 11 southern states. U. S. Dep. Agr. Handbook 389. 216 pp.
- Leonard, W. H., and J. H. Martin. 1963. Cereal crops. Macmillan Co., New York. 824 pp.
- Lewis, J. C. 1973. The world of the wild turkey. J. P. Lippincott Co., Philadelphia, Pa.
- Lewis, R. R., Jr., and C. S. Lewis. 1978. Bird use and vegetation succession of dredged material islands in Florida. Technical Report D-78-14. Volume 2. U. S. Army Engineer Waterways Exp. Sta., Vicksburg, Miss.
- Long, R. W. and O. Lakela. 1971. A flora of tropical Florida. University of Miami Press, Miami, Fla. 962 pp.

- Lowery, G. H. 1960. Louisiana birds. Louisiana State University Press, Baton Rouge, La. 567 pp.
- Lowery, G. H. 1974. The mammals of Louisiana and its adjacent waters. Louisiana State University Press, Baton Rouge, La. 565 pp.
- Mallette, R. D. [1970?]. Upland game of California, 2nd ed. Cal. Dep. Fish and Game, Sacramento, Calif. 76 pp.
- Mann, R., W. Niering, R. Sabatini, and P. Wells. 1977. Landscape concept development for confined dredged material sites. U. S. Army Engineer Waterways Exp. Sta. Contract Report D-75-5. Vicksburg, Miss. 168 pp.
- Martin, A. C., and F. M. Uhler. 1951. Food of game ducks in the United States and Canada. U. S. Dep. of Interior, Fish and Wildl. Serv. Res. Report 30. 308 pp.
- Martin, A. C., H. S. Zim, and A. L. Nelson. 1951. American wildlife and plants. Dover Publications, New York. 500 pp.
- McAtee, W. L., ed. 1945. The ring-necked pheasant and its management in North America. The American Wildlife Institute, Washington, D. C. xii + 320 pp.
- McVaugh, R. 1947. Establishment of vegetation on sand-flats along the Hudson River, New York. Ecology 28(2):189-193.
- McVaugh, R. 1957. Establishment of vegetation on sand-flats along the Hudson River, New York. -II. The period 1945 - 1955. Ecology 38(1):23-29.
- Milne, R. C. 1963. A habitat description and evaluation, semiquantitative food habit analysis, and population study of the nutria, Myocastor coypus (Molina) Kerr, on Hatteras Island, North Carolina. M.S. Thesis. North Carolina State University, Raleigh, N. C. 116 pp.
- Monte, J. A. 1974. Man induced vegetational change in the Bayou Lafourche Basin, Louisiana: Vegetational succession on spoil banks. PhD Thesis. Louisiana State University, Baton Rouge, La. 194 pp.
- Montz, G. N. 1972. A seasonal study of the vegetation of levees. Castanea 37(2):140-146.
- Montz, G. N. 1976. Vegetational studies conducted in Atchafalaya Bay, Louisiana. U. S. Army Corps of Engineers, New Orleans District Environmental Section. 35 pp. Mimeo.

- Newberry, D. W. 1973. A contribution toward a bibliography of California furbearers. California Dep. Fish and Game, Sacramento, Calif. 148 pp.
- North Carolina Wild Flower Preservation Society, Inc. 1977. North Carolina native plant propagation handbook. N. C. Wild Flower Preservation Soc., Inc., Chapel Hill, N. C. 79 pp.
- North Carolina Wildlife Resources Commission. 1974. A checklist of North Carolina mammalian species. N. C. Wildl. Resour. Comm., Raleigh, N. C. 30 pp.
- Oosting, H. J. 1954. Ecological processes and vegetation of the maritime strand in the southeastern United States. The Bot. Rev. 20(4):226-262.
- Palmer, R. S., ed. 1962. Handbook of North American birds. Volume 1, Loons through flamingos. Yale University Press, New Haven, Conn. 567 pp.
- Paradiso, J. L. 1969. Mammals of Maryland. U. S. Dep. of Interior, Fish and Wildl. Serv. North American Fauna 66. iv + 193 pp.
- Parnell, J. F., D. M. DuMond, and R. N. Needham. 1978. A comparison of plant succession and bird utilization on diked and undiked dredged material islands in the North Carolina estuaries. U. S. Army Engineer Waterways Exp. Sta. Tech. Report D-78-9. Vicksburg, Miss.
- Parnell, J. F., and R. F. Soots, Jr. 1975a. Herring and great black-backed gulls nesting in North Carolina. Auk 92(1):154-157.
- Parnell, J. F., and R. F. Soots, Jr. 1975b. Proceedings of a conference on management of dredge islands in North Carolina estuaries. University of North Carolina Sea Grant Program Publ. UNC-SG-75-01. 142 pp.
- Parnell, J. F., and R. F. Soots, Jr. 1976. Caspian tern nesting in North Carolina. The Chat 40(1):14-15.
- Pearson, T. G., C. S. Brimley, and H. H. Brimley. 1959. Birds of North Carolina, 3rd ed. Revised by D. L. Wray and H. T. Davis. N. C. State Mus. Nat. Hist. 434 pp.
- Peters, C. F., K. O. Richter, D. A. Manuwal, and S. G. Herman. 1978. Colonial nesting sea and wading bird use of estuarine islands in the Pacific northwest. Technical Report D-78-17. U. S. Army Engineer Waterways Exp. Sta., Vicksburg, Miss.
- Peterson, R. T. 1961. A field guide to the western birds. Houghton Mifflin Co., Boston, Mass. 240 pp.

- Peterson, R. T. 1967. A field guide to the birds: eastern land and water birds. Houghton Mifflin Co., Boston, Mass. 290 pp.
- Pettingill, O. S., Jr. 1970. Ornithology in laboratory and field. Burgess Publishing Company, Minneapolis, Minn. 524 pp.
- Quay, T. L. 1947. Winter birds of upland plant communities. *Auk* 64(3):382-388.
- Quay, T. L. 1959. The birds, mammals, reptiles, and amphibians of Cape Hatteras National Seashore Recreational Area. U. S. Dep. Interior Natl. Park Serv. 88 pp. Mimeo.
- Radford, A. E., H. E. Ahles, and C. R. Bell. 1968. Manual of the vascular flora of the Carolinas. University of North Carolina Press, Chapel Hill, N. C. 1183 pp.
- Reilly, E. M., Jr. 1968. The Audubon illustrated handbook of American birds. McGraw-Hill Book Co., New York. 524 pp.
- Robbins, C. S., B. Brunn, and H. S. Zim. 1966. Birds of North America. Golden Press, New York. 340 pp.
- Robertson, G. C. 1973. An evaluation of autumn olive and multiflora rose as wildlife plants in West Virginia. M.S. Thesis. West Virginia University, Morgantown, W. Va. 47 pp.
- Rosene, W., Jr. 1969. The bobwhite quail: its life and management. Rutgers University Press, New Brunswick, N. J. 418 pp.
- Sanderson, G. C., ed. 1977. Management of migratory shore and upland game birds in North America. Int. Assoc. Fish and Wildl. Agencies, Washington, D. C. 358 pp.
- Scharf, W. 1977. Nesting and migration areas of birds in the U. S. Great Lakes. U. S. Dep. of Interior, Fish and Wildl. Serv. Interim Report USFWS/035.77-2. In press.
- Scharf, W. 1978. Colonial birds nesting on manmade and natural sites in the U. S. Great Lakes. Technical Report D-78-10. U. S. Army Engineer Waterways Exp. Sta., Vicksburg, Miss.
- Schery, R. W. 1952. Plants for man. Prentice-Hall, Englewood Cliffs, N. J. 564 pp.
- Schopmeyer, S. C. 1974. Seeds of woody plants in the United States. U. S. Dep. Agr. Handbook 450. 883 pp.

- Schreiber, R. W., and E. A. Schreiber. 1978. Bird use and vegetation succession on dredged material islands in Florida. Technical Report D-78-14. Volume 1. U. S. Army Engineer Waterways Exp. Sta., Vicksburg, Miss.
- Schwartz, C. W., and E. R. Schwartz. 1974. The wild mammals of Missouri. University of Missouri Press and Missouri Conservation Commission, Columbia, Mo. 341 pp.
- Seltz, J. 1976. The dune book - how to plant grasses for dune stabilization. University of North Carolina Sea Grant Program Publ. UNC-SG-76-16. 13 pp.
- Seymour, G. 1968. Furbearers of California. California Dep. Fish and Game, Sacramento, Calif. 57 pp.
- Smith, J. L. 1975. Impact of dredging on the vegetation in Gray's Harbor. Appendix F. Wash. Dep. Game, Olympia, Wash. 121 pp.
- Soots, R. F., Jr., and M. C. Landin. 1978. The development and management of avian habitat on dredged material islands. Technical Report in preparation. U. S. Army Engineer Waterways Exp. Sta., Vicksburg, Miss.
- Soots, R. F., Jr., and J. F. Parnell. 1975a. Introduction to the nature of dredge islands and their wildlife in North Carolina and recommendations for management. Pages 1-34 in J. F. Parnell and R. F. Soots, Jr., eds. Proceedings of a conference on management on dredge islands in North Carolina estuaries. University of North Carolina Sea Grant Program Publ. UNC-SG-75-01.
- Soots, R. F., Jr., and J. F. Parnell. 1975b. Ecological succession of breeding birds in relation to plant succession on dredge islands in North Carolina estuaries. University of North Carolina Sea Grant Program Publ. UNC-SC-75-27. 91 pp.
- Spindler, M. A. 1973. Fall vegetation on the spoil banks of Superior Canal, Cameron Parish, Louisiana: Vegetation analysis of a canal spoil bank community in the southwest Louisiana coastal marsh. Louisiana State University, Baton Rouge, La. 43 pp. Mimeo.
- Spindler, M. A., and R. E. Noble. 1974. Fall vegetation on the spoil banks of Superior Canal, Cameron Parish, Louisiana. Proc. La. Acad. Sci. 37:74-88.
- Stebbins, R. C. 1966. A field guide to western reptiles and amphibians. Houghton Mifflin Co., Boston, Mass. 279 pp.
- Steyermark, J. A. 1963. Flora of Missouri. Iowa State University Press, Ames, Iowa. lxxxiii + 1728 pp.

- Stoddard, H. L. 1931. The bobwhite quail--its habits, preservation and increase. Charles Schribner's Sons, New York. 559 pp.
- Sweeney, R. A. 1973. Present and potential ecological status of the diked disposal sites in Buffalo Harbor, Buffalo, New York. New York Sea Grant Institute Report NYSSGP-RS-75-004. 27 pp.
- Taylor, W. P., ed. 1956. The deer of North America. The Stackpole Co., Harrisburg, Pa. and the Wildlife Management Institute, Washington, D. C. 668 pp.
- Thompson, D. H. and M. C. Landin. 1978. An aerial survey of water bird colonies along the upper Mississippi River and their relationship to dredged material deposits. Technical Report D-78-13. U. S. Army Engineer Waterways Exp. Sta., Vicksburg, Miss.
- Udvardy, M. D. F. 1977. The Audubon Society field guide to North American birds: western region. Alfred A. Knopf, New York.
- U. S. Department of Agriculture. 1948. Grass - the yearbook of agriculture 1948. U. S. Government Printing Office, Washington, D. C. 892 pp.
- U. S. Department of Agriculture, Agricultural Research Service. 1970. Selected weeds of the United States. U. S. Dep. Agr. Handbook 366. 463 pp.
- U. S. Department of Agriculture, Soil Conservation Service. 1969-1976. Plants for conservation in the northeast. U. S. Dep. Agr. Soil Conserv. Serv. Conserv. Plant Sheets No. 1-57. N. J. 43, 965, 1551.
- Van Dersal, W. R. 1938. Native woody plants of the United States, their erosion-control and wildlife values. U. S. Dep. Agr. Misc. Publ. 303. 362 pp.
- Viereck, L. A., and E. L. Little, Jr. 1974. Guide to Alaska trees. U. S. Dep. Agr. Handbook 472. 98 pp.
- Vines, R. A. 1960. Trees, shrubs and woody vines of the southwest. University of Texas Press, Austin, Tex. 1104 pp.
- Walsh, M. R., and M. D. Malkasian. 1978. Productive land use of dredged material containment areas: synthesis report. Report in preparation. U. S. Army Engineer Waterways Experiment Station, Vicksburg, Miss.
- Weigand, J. P., and R. G. Janson. 1976. Montana's ring-necked pheasant: history, ecology, and management. Mont. Dep. Fish and Game, Helena, Mont. 178 pp.

- Wiedemann, A. M., L. J. Dennis, and F. H. Smith. 1969. Plants of the Oregon coastal dunes. Oregon State University Book Stores, Corvallis, Ore. 117 pp.
- Wilbur, R. L. 1963. The leguminous plants of North Carolina. North Carolina Agr. Exp. Sta. Tech. Bull. 151. 294 pp.
- Yeager, L. E., and K. G. Hay. 1955. A contribution toward a bibliography on the beaver. Colorado Dep. Game and Fish Tech. Bull. 1. 102 pp.
- Yelverton, C. S. and T. L. Quay. 1959. Food habits of the Canada goose at Lake Mattamuskeet, North Carolina. North Carolina Wildl. Resour. Comm. Bull. 44 pp.

BIBLIOGRAPHY

1. The following references are not cited in the text, but many were reviewed and used by the CZR study team during preparation of this handbook. Other references included are examples of material available to persons planning habitat development programs for dredged material areas. Hundreds of additional wildlife and botanical references were identified during the study, but were not particularly relevant or readily available.

2. A wide spectrum of biological insight, experience, and published information is available to the handbook user who uses regional libraries and interviews various agency personnel and private consultants. Local experts should not be overlooked.

3. To facilitate use of the Bibliography, it has been divided under four subheadings: Plants, Birds, Mammals, and Miscellaneous.

Plants

- Au, Shu-Fun. 1974. Vegetation and ecological processes on Shackleford Bank, North Carolina. National Park Serv. Sci. Monogr. Ser. 6. 86 pp.
- Bailey, L. H. 1949. Manual of cultivated plants. Macmillan Co., New York. 1116 pp.
- Baskett, T. S. 1955. Experimental trials of wildlife food and cover plants. Missouri Agr. Exp. Sta. Res. Bull. 584. 24 pp.
- Bramble, W. C., and R. H. Ashley. 1955. Natural revegetation of spoil banks in central Pennsylvania. Ecology 36:417-423.
- Cates, G. R., and G. H. Orians. 1975. Successional status and the palatability of plants to generalized herbivores. Ecology 56: 410-418.
- Chapman, E. W. 1975. Source of wildlife planting materials. U. S. Dep. Agr. Soil Conserv. Serv., Auburn, Alabama. Advisory memo. 4 pp.
- Cook, D. B., and F. C. Edminster. 1944. Survival and growth of shrubs planted for wildlife in New York. J. Wildl. Manage. 8(3):185-191.

- Craig, R. M. 1974a. Coastal dune vegetation. Proc. Florida State Horticult. Soc. 87:548-552.
- Craig, R. M. 1974b. Natural vegetation on Florida's coastal dunes. Proc. Soil and Crop Sci. Soc. of Florida 34:169-171.
- Craig, R. M. 1975. Woody vegetation for coastal dune areas. Proc. Florida State Horticult. Soc. 88:428-434.
- Craig, R. M. 1976. Grasses for coastal dune areas. Proc. Florida State Hort. Soc. 89:353-355.
- Davis, R. J. 1952. Flora of Idaho. William C. Brown Co., Dubuque, Id. 828 pp.
- Davison, V. E. 1960. Lespedezas for quail and good land use. U. S. Dep. Agr. Leaflet 373. 8 pp.
- Eck, H. V., R. F. Dudley, R. H. Ford, and G. W. Gnatt, Jr. 1968. Sand dune stabilization along streams in the southern Great Plains. J. Soil and Water Conserv. 23(4):131-134.
- Edminster, F. C., and R. M. May. 1951. Shrub plantings for soil conservation and wildlife cover in the northeast. U. S. Dep. Agr. Circular 887. 68 pp.
- Emery, D., and J. Broughton. 1969. Native plants for southern California gardens. Santa Barbara Botanic Garden Leaflet 1(12): 113-136.
- Ferris, R. S. 1970. Flowers of Point Reyes National Seashore. University of California Press, Berkeley and Los Angeles, Calif. 119 pp.
- Flood, B. S., M. E. Sangster, R. D. Sparrowe, and T. S. Baskett. 1977. A handbook for habitat evaluation procedures. U. S. Dep. of Interior, Fish and Wildl. Serv. Resour. Publ. 132. 77 pp.
- Florida Agricultural Extension Service, Institute of Food and Agricultural Sciences. (1975). Weeds of the southern United States. University of Florida, Gainesville, Fla. 45 pp.
- Franklin, J. F., and C. T. Dyrness. 1973. Natural vegetation of Oregon and Washington. U. S. Dep. Agr. Forest Serv. Gen. Tech. Report PNW-8. 417 pp.
- Gilkey, H. M., and L. J. Dennis. 1973. Handbook of northwestern plants. Oregon State University Bookstores, Corvallis, Ore. 505 pp.

- Gleason, H. A., and A. Cronquist. 1963. Manual of vascular plants of northeastern United States and adjacent Canada. D. Van Nostrand Co., New York. 810 pp.
- Gould, F. W. 1975a. Texas plants, a checklist and ecological summary. Texas Agr. Exp. Sta., College Station, Tex. 121 pp.
- Gould, F. W. 1975b. The grasses of Texas. Texas A & M University Press, College Station, Tex. 653 pp.
- Great Plains Flora Association. 1977. Atlas of the flora of the Great Plains. Iowa State University Press, Ames. 600 pp.
- Guernsey, W. J. 1970. Sericea lespedeza, its use and management. U. S. Dep. Agr. Farmers' Bull. 2245. 29 pp.
- Halls, L. K., ed. 1977. Southern fruit-producing woody plants used by wildlife. U. S. Dep. Agr. Forest Serv. Gen. Tech. Report 50-16. 235 pp.
- Hanson, A. A. 1972. Grass varieties in the United States. U. S. Dep. Agr. Handbook 170. 124 pp.
- Hotchkiss, N. 1970. Common marsh plants of the United States and Canada. U. S. Dep. of Interior, Bur. Sport Fish. and Wildl., Resour. Publ. 93. 99 pp.
- Kearney, T. H., and R. H. Peebles, eds. 1951. Arizona flora. University of California Press, Berkeley, Calif. 1032 pp.
- Little, E. L., Jr. 1971. Atlas of United States trees. Volume 1, conifers and important hardwoods. U. S. Dep. Agr. Misc. Publ. 1146. n.p.
- Mason, H. L. 1957. A flora of the marshes of California. University of California Press, Berkeley and Los Angeles, Calif. viii + 878 pp.
- McAtee, W. L. 1936. Groups of plants valuable for wildlife utilization and erosion control. U. S. Dep. Agr. Circular 412. 11 pp.
- McKell, C. M., J. P. Blaisdell, and J. R. Goodin. 1972. Wildland shrubs--their biology and utilization. U. S. Dep. Agr. Forest Serv. Gen. Tech. Report INT-1. 494 pp.
- McMinn, H. E. 1951. An illustrated manual of California shrubs. University of California Press, Berkeley and Los Angeles, Calif. 663 pp.
- Mohlenbrock, R. H. 1975. Guide to the vascular flora of Illinois. Southern Illinois University Press, Carbondale, Ill. 494 pp.

- Montz, G. N. 1976. Vegetational studies associated with the 1973 and 1975 operations of the Bonnet Carre Spillway in Louisiana. U. S. Army Corps of Engineers, New Orleans District, Environmental Quality Section. 49 pp. Mimeo.
- Munz, P. A. 1964. Shore wildflowers of California, Oregon, and Washington. University of California Press, Berkeley and Los Angeles, Calif.
- Munz, P. A., and D. D. Keck. 1973. A California flora with supplement. University of California Press, Berkeley and Los Angeles, Calif. 1681 + 224 pp.
- Neeland, R. W. 1973. Important trees of eastern forests. U. S. Dep. Agr. Forest Serv. Southern Region, Atlanta, Ga. 111 pp.
- Peck, M. E. 1961. A manual of the higher plants of Oregon, 2nd ed. Binfords and Mort, Publishers, Portland, Or. 936 pp.
- Preston, R. J., Jr. 1976. North American trees, 2nd ed. Massachusetts Institute of Technology Press, Cambridge, Mass. 395 pp.
- Raven, P. 1966. Native shrubs of southern California. University of California Press, Berkeley and Los Angeles, Calif. 132 pp.
- Rehder, A. 1940. Manual of cultivated trees and shrubs hardy in North America. Macmillan Co., New York. xxx + 996 pp.
- Rosene, W., Jr. 1952. Care and maintenance of bicolor lespedeza. Soil Conserv. 17(7):151-153.
- Rosene, W., Jr. 1953. Growing bicolor lespedeza in southeastern states. U. S. Dep. Interior, Fish Wildl. Serv., Wildl. Leaflet 350. 3 pp.
- Rosene, W., Jr. 1955. Recommendations for the culture of lespedeza bicolor. J. Wildl. Manage. 19(1):84-88.
- Scott, R. F. 1965. Problems of multiflora rose spread and control. Trans. N. Am. Wildl. Nat. Resour. Conf. 30:360-378.
- Small, J. K. 1972a. Manual of the southeastern flora. Part 1. Hafner Publishing Co., New York. 774 pp. [First published in 1933.]
- Small, J. K. 1972b. Manual of the southeastern flora. Part 2. Hafner Publishing Co., New York. 779 pp. [First published in 1933.]

- Springer, D. K., H. A. Fribourg, J. D. Burns, and K. E. Graetz. 1969. Roadside revegetation and beautification in Tennessee: the use of grasses, legumes and other selected plants. U. S. Dep. Agr. Soil Conserv. Serv., and Insti. of Agr., Univ. of Tenn., Knoxville, Tenn. 22 pp.
- Stephens, H. A. 1973. Woody plants of the North Central Plains. University Press of Kansas, Lawrence/Manhattan/Wichita. 530 pp.
- Stevens, O. A. 1950. Handbook of North Dakota plants. North Dakota Agricultural College, Fargo, N. D. 324 pp.
- U. S. Department of Agriculture Forest Service. 1972. Seed and planting stock dealers. 26 pp.
- U. S. Department of Agriculture Soil Conservation Service. 1973. Vendors of seeds used in soil and water conservation for use in south region. U. S. Dep. Agr. Soil Conserv. Serv., Fort Worth, Tex. 18 pp. Mimeo.
- U. S. Department of Agriculture Soil Conservation Service. 1975. Herbaceous seeding guide for California by major land resource areas. California Dep. Transportation Office of Landscape and Architectural Design, Sacramento, Calif. 26 pp. Mimeo.
- U. S. Department of Agriculture Soil Conservation Service. 1976a. Sources of planting stock and seed of conservation plants used in the northeast - 1976 and 1977. U. S. Dep. Agr. Soil Conserv. Serv., Northeast Tech. Serv. Center, Broomall, Pa. 12 pp. Mimeo.
- U. S. Department of Agriculture Soil Conservation Service. 1976b. Partial list of commercial sources of plant materials for wild-life plantings in Texas. Plant Materials Memo. TX-11 U. S. Dep. Agr. Soil Conserv. Serv., Fort Worth, Tex. 7 pp.
- U. S. Department of Agriculture Soil Conservation Service. 1976c. Progress in plant materials. U. S. Dep. Agr. Soil Conserv. Serv. Plant Materials Center, Corvallis, Or. 28 pp.
- U. S. Department of Agriculture Soil Conservation Service. 1977a. Sources of conservation plant materials for North and South Carolina. U. S. Dep. Agr. Soil Conserv. Serv. 4 pp. Mimeo.
- U. S. Department of Agriculture Soil Conservation Service. 1977b. Commercial sources of plant materials - California. U. S. Dep. Agr. Soil Conserv. Serv. 9 pp.
- U. S. Department of Agriculture Soil Conservation Service. 1977c. Fitzpatrick Island field evaluation planting advanced evaluation (draft). U. S. Dep. Agr. Soil Conserv. Serv. Plant Materials Center, Corvallis, Ore. 5 pp. Mimeo.

- U. S. Department of Agriculture Soil Conservation Service. 1977d. Sauvie Island game management area - Columbia River dredge spoils initial and advanced evaluation planting (draft). U. S. Dep. Agr. Soil Conserv. Serv. Plant Materials Center, Corvallis, Ore. 17 pp. Mimeo.
- U. S. Department of Agriculture Soil Conservation Service and Oregon Coastal Conservation and Development Commission. 1975. Beaches and dunes of the Oregon coast. U. S. Dep. Agr. Soil Conserv. Serv., Portland, Ore. 161 pp.
- Westmoreland, W. G. 1955. Some weedy plants of North Carolina. North Carolina Agr. Extension Serv., Extension Circular 390. 58 pp.
- Wiedemann, A. M. 1966. Contributions to the plant ecology of the Oregon coastal sand dunes. PhD Thesis. Oregon State University. University Microfilms, Ann Arbor, Mich. 255 pp.
- Wilde, S. A. 1946. Soil fertility standards for game food plants. J. Wildl. Manage. 10:77-81.
- Woodhouse, W. W., E. D. Seneca, and S. W. Broome. 1976. Ten years of development of man-initiated coastal barrier dunes in North Carolina. North Carolina Agr. Exp. Sta. Bull. 453. 53 pp.

Birds

- Baerg, W. J., and L. O. Warren. 1949. The bobwhite quail in Arkansas. Arkansas Agr. Exp. Sta. Bull. 488. 46 pp.
- Bailey, R. W. 1976. The wild turkey's management and future in North Carolina. North Carolina Wildl. Resour. Comm., Raleigh, N. C. 17 pp.
- Baldwin, W. P., Jr., and C. O. Handley. 1946. Winter food of bobwhite quail in Virginia. J. Wildl. Manage. 10(2):142-149.
- Baumgartner, F. M., M. J. Morris, J. L. Steele, and J. E. Williams. 1952. Oklahoma bobwhite food relations. Trans. N. Am. Wildl. Conf. 17:338-359.
- Berner, A., and L. W. Gysel. 1969. Habitat analysis and management considerations of ruffed grouse for a multiple use area in Michigan. J. Wildl. Manage. 33:769-778.
- Brunswig, N. L., and A. S. Johnson. 1972. Bobwhite quail foods and quail populations on pine plantations in the Georgia piedmont during the first seven years following site preparation. Proc. Southeastern Assoc. Game and Fish Comm. 26:97-107.
- Burger, G. V., and J. P. Linduska. 1967. Habitat management related to bobwhite populations at Remington Farms. J. Wildl. Manage. 31(1):1-12.
- Campbell, H., D. K. Martin, P. E. Ferkovich, and B. K. Harris. 1973. Effects of hunting and some other environmental factors on scaled quail in New Mexico. Wildl. Monogr. 34. 49 pp.
- Chabreck, R. H., R. K. Yancey, and L. McNease. 1974. Duck usage of management units in the Louisiana coastal marsh. Proc. Southeastern Assoc. Game and Fish Comm. 28:507-516.
- Chenault, T. P. 1940. The phenology of some bobwhite food and cover plants in Brazos County, Texas. J. Wildl. Manage. 4(4):359-368.
- Davis, C. A., and M. W. Anderson. 1973. Seasonal food use by mourning doves in the Mesilla Valley, south-central New Mexico. New Mexico State University Agr. Exp. Sta. Bull. 612. 21 pp.

- Davison, V. E. 1942. Bobwhite foods and conservation farming. J. Wildl. Manage. 6(2):97-109.
- Dillon, O. W., Jr. 1975. Invite birds to your home - conservation plantings for the southeast. U. S. Dep. Agr. Soil Conserv. Service PA 1093. U. S. Government Printing Office, Washington, D. C. 15 pp.
- Dimmick, R. W. 1971. The influence of controlled burning on nesting patterns of bobwhite in west Tennessee. Proc. Southeastern Assoc. Game and Fish Comm. 25:149-155.
- Downing, R. L. 1973. A preliminary nesting survey of least terns and black skimmers in the east. Am. Birds 27(6):946-949.
- Edminster, F. C. 1954. American game birds. Castle Books, New York. 490 pp.
- Ellis, J. A., W. R. Edwards, and K. P. Thomas. 1969. Responses of bobwhites to management in Illinois. J. Wildl. Manage. 33(4):749-762.
- Hall, H. M. 1960. A gathering of shore birds. Devin-Adair Co., New York. 242 pp.
- Hamor, W. H., H. G. Uhlig, and L. V. Compton. 1968. Ponds and marshes for wild ducks on farms and ranches in the northern plains. U. S. Dep. Agr. Farmers' Bull. 2234. 16 pp.
- Hansen, L. E., and R. Progulske. 1973. Movements and cover preferences of pheasant in South Dakota. J. Wildl. Manage. 37(4):454-461.
- Hanson, W. R., and R. J. Miller. 1961. Edge types and abundance of bobwhites in southern Illinois. J. Wildl. Manage. 25(1):71-76.
- Hayne, D. A. 1975. Experimental increase of mourning dove bag limit in eastern management unit, 1965-1972. Southeastern Assoc. Game and Fish Comm. Tech. Bull. 2. 56 pp.
- Korschgen, L. J. 1952. Analysis of the food habits of the bobwhite quail in Missouri. Missouri Dep. Conserv. P-R Proj. 13-R-4. 59 pp.
- Korschgen, L. J. 1955. Food habits of the mourning dove in Missouri. Missouri Conserv. Comm. Fish and Game Div. P-R Series 12. 31 pp.
- Korschgen, L. J. 1964. Foods and nutrition of Missouri and midwestern pheasants. Trans. N. Am. Wildl. Nat. Resour. Conf. 29:159-181.

- Korschgen, L. J. 1966. Foods and nutrition of ruffed grouse in Missouri. *J. Wildl. Manage.* 30(1):86-100.
- Landers, J. L., and A. S. Johnson. 1976. Bobwhite quail food habits in the southeastern United States with a seed key to important foods. Tall Timbers Research Sta. Misc. Publ. 4. 90 pp.
- Larimer, E. J. 1960. Winter foods of the bobwhite in southern Illinois. *Illinois Nat. Hist. Sur. Biol. Notes* 42. 35 pp.
- Ligon, J. S. 1961. New Mexico birds and where to find them. University of New Mexico Press, Albuquerque, N. M. 360 pp.
- Liscinsky, S. A. 1965. The American woodcock in Pennsylvania. *Pennsylvania Game Comm., Harrisburg, Pa.* 32 pp.
- Marriage, D. L. 1975. Invite birds to your home - conservation plantings for the northwest. U. S. Dep. Agr. Soil Conserv. Service PA 1094. U. S. Government Printing Office, Washington, D. C. 19 pp.
- McAtee, W. L. 1936. Fruits attractive to birds. U. S. Dep. Agr. Bur. Biol. Surv. Wildl. Res. and Manage. Leaflets 41-50.
- McMurry, S. L. 1971. Nesting and development of the reddish egret (*Dichromanassa rufescens* Gmelin) on a spoil bank chain in the Laguna Madre. M. S. Thesis. Texas A & I University, Kingsville, Tex. 78 pp.
- Michael, V. C., and S. L. Beckwith. 1955. Quail preference for seed of farm crops. *J. Wildl. Manage.* 19(2):281-296.
- Mitchell, T. R. 1953. Management of the bobwhite quail in North Carolina. Game Division Leaflet. North Carolina Wildl. Resour. Comm., Raleigh, N. C. 6 pp.
- Neely, W. W., and V. E. Davison. 1966. Wild ducks on farmland in the south. U. S. Dep. Agr. Farmers' Bull. 2218. 14 pp.
- Nestler, R. B. 1945. Some publications on upland game birds. U. S. Dep. of Interior, Fish and Wildl. Serv., Wildl. Leaflet 265. 11 pp.
- Nestler, R. B. 1949. Acceptance of seeds of four legumes by the bobwhite quail. *J. Wildl. Manage.* 13(1):143-144.
- Nestler, R. B., and W. W. Bailey. 1944. Sumac fruit as a food for bobwhite quail. *Am. Midl. Nat.* 31(3):689-696.

- North Carolina Wildlife Resources Commission. 1975. The ruffed grouse. Game Division Leaflet. North Carolina Wildl. Resour. Comm., Raleigh, N. C. 5 pp.
- Oregon State Game Commission. 1972. Shorebirds of Oregon. Information Leaflet 20. Oregon State Game Comm., Portland, Ore. 4 pp.
- Parnell, J. F., and T. L. Quay. 1962. The populations, breeding biology, and environmental relations of the black duck, gadwall, and blue-winged teal at Pea and Bodie Islands, North Carolina. Proc. Southeastern Assoc. Game and Fish Comm. 16:53-66.
- Phillips, A., J. Marshall, and G. Monson. 1964. The birds of Arizona. University of Arizona Press, Tucson, Ariz. 239 pp.
- Pough, R. H. 1951. Audubon water bird guide. Doubleday Co., Garden City, N. Y. 352 pp.
- Quay, T. L. 1947. Winter birds of upland plant communities. Auk 64(3):382-388.
- Robel, R. J., R. M. Case, A. R. Bisset, and T. M. Clement, Jr. 1974. Energetics of food plots in bobwhite management. J. Wildl. Manage. 38(4):653-664.
- Rosene, W., Jr. 1951. Breeding bird populations of upland field borders. J. Wildl. Manage. 15(4):434-436.
- Rosene, W., Jr. 1956a. An appraisal of bicolar lespedeza in quail management. J. Wildl. Manage. 20(2):104-110.
- Rosene, W., Jr. 1956b. Management techniques which encourage bobwhite quail to nest. Proc. Southeastern Assoc. Game and Fish Comm. 10:126-128.
- Rue, L. L., III. 1973. Game birds of North America. Outdoor Life and Harper & Row, New York. 490 pp.
- Simersky, B. L. 1971. Competition and nesting success of four species of herons on four spoil islands in the Laguna Madre. M. S. Thesis. Texas A & I University, Kingsville, Tex. 92 pp.
- Sprunt, A., Jr. 1954. Florida bird life. National Audubon Society, New York.

- Sprunt, A., Jr., and E. B. Chamberlain. 1949. South Carolina bird life. University of South Carolina Press, Columbia, S. C. 585 pp.
- Stanford, J. A. 1952. Whirring wings: The bobwhite quail in Missouri. Missouri Conserv. Comm., Jefferson City, Mo. 89 pp.
- Stewart, R. E., and C. S. Robbins. 1958. Birds of Maryland and the District of Columbia. U. S. Dep. of Interior, Fish and Wildl. Serv., North American Fauna 62. 401 pp.
- Trautman, C. G. 1952. Pheasant food habits in South Dakota and their economic significance to agriculture. South Dakota Dep. Game, Fish, and Parks Tech. Bull. 1. 89 pp.
- Tuck, L. M. 1972. The snipes: a study of the genus Capella. Canadian Wildl. Serv. Monogr. Series 5. 428 pp.
- Weber, A. J. 1975. Fall and winter food habits of the bobwhite quail in the sandhills of North Carolina. Proc. Southeastern Assoc. Game and Fish Comm. 29:687-694.

Mammals

- Alcoze, T. M., and E. G. Zimmerman. 1973. Food habits and dietary overlap of two heteromyid rodents from the mesquite plains of Texas. *J. Mammal.* 54(4):900-908.
- Bailey, J. A. 1969. Exploratory study of nutrition of young cottontails. *J. Wildl. Manage.* 33(2):346-353.
- Blair, W. F. 1936. The Florida marsh rabbit. *J. Mammal.* 17(3):197-207.
- Boeker, E. L., V. E. Scott, H. G. Reynolds, and B. A. Donaldson. 1972. Seasonal food habits of mule deer in southwestern New Mexico. *J. Wildl. Manage.* 36(1):56-63.
- Bookhout, T. A. 1965. The snowshoe hare in upper Michigan: its biology and feeding coactions with white-tailed deer. Michigan Dep. Conserv. Res. and Develop. Report 38. 191 pp.
- Brown, E. R. 1961. The black-tailed deer of western Washington. *Biol. Bull.* 13. Washington State Game Dep., Olympia, Wash. 124 pp.
- Cahalane, V. H. 1947. *Mammals of North America.* Macmillan Co., New York. 682 pp.
- Carpenter, R. G., and H. R. Siegler. 1974. A list of New Hampshire mammals and their distribution. New Hampshire Fish and Game Dep., Concord, N. H. 13 pp.
- Cowan, I. M. 1941. The ecological relationships of the food of the Columbian black-tailed deer, Odocoileus hemionus columbianus (Richardson), in the coast forest region of southern Vancouver Island, British Columbia. *Ecol. Monogr.* 15:109-139.
- Dalke, P. D., and P. R. Sime. 1941. Food habits of the eastern and New England cottontails. *J. Wildl. Manage.* 5(2):216-228.
- Davis, R. B., and C. K. Winkler. 1968. Brush versus cleared range as deer habitat in southern Texas. *J. Wildl. Manage.* 32 (2):321-329.
- Dills, G. G. 1970. Effects of prescribed burning on deer browse. *J. Wildl. Manage.* 34(3):540-545.
- Solly, F. B. 1962. *Mammals of Georgia.* University of Georgia Press, Athens, Ga. 218 pp.

- Golly, F. B. 1966. South Carolina mammals. Charleston Museum, Charleston, S. C. 181 pp.
- Hill, E. P. 1972. The cottontail rabbit in Alabama. Alabama Agr. Exp. Sta. Bull. 440. 103 pp.
- Klein, D. R. 1970. Food selection by North American deer and their response to over-utilization of preferred plant species. Pages 25-46 in A. Watson, ed. Animal populations in relation to their food resources. Blackwell Scientific Publishing Co., Oxford, England.
- Korschgen, L. J. 1954. A study of the food habits of Missouri deer: including usage of agricultural crops and browse indicator plants. Missouri Conserv. Comm. 43 pp.
- Korschgen, L. J. 1973a. Principal year-round foods of cottontails in Missouri. Missouri Dep. Conserv. P-R Proj. W13-R-27. Job 1. 47 pp.
- Korschgen, L. J. 1973b. Nutritional values of primary rabbit foods and their relationships to average diets. Missouri Dep. Conserv. P-R Proj. W13-R-27. Job 2. 10 pp.
- Lay, D. W. 1969. Foods and feeding habits of white-tailed deer. Pages 8-13 in Proceedings of white-tailed deer in the southern forest habitat symposium. U. S. Dep. Agr. Forest Serv., Southern Forest Exp. Sta.
- Lowe, C. E. 1958. Ecology of the swamp rabbit in Georgia. J. Mammal. 39:116-127.
- Lowe, C. H., ed. 1964. The vertebrates of Arizona. University of Arizona Press, Tucson, Ariz. 270 pp.
- Martinka, C. J. 1968. Habitat relationships of white-tailed and mule deer in northern Montana. J. Wildl. Manage. 32(3):558-565.
- Nixon, C. M., M. W. McClain, and K. R. Russell. 1970. Deer food habits and range characteristics in Ohio. J. Wildl. Manage. 34:870-886.
- North Carolina Wildlife Resources Commission. 1973. The eastern cottontail rabbit in North Carolina. Game Division Leaflet. N. C. Wildl. Resour. Comm., Raleigh, N. C. 6 pp.

- North Carolina Wildlife Resources Commission. 1974. Guide for the establishment of deer restoration areas. N. C. Wildl. Resour. Comm., Raleigh, N. C. 2 pp.
- North Carolina Wildlife Resources Commission. 1975. The beaver. Game Division Leaflet. N. C. Wildl. Resour. Comm., Raleigh, N. C. 9 pp.
- Orr, R. T. 1940. The rabbits of California. California Acad. Sci. Occasional Paper 19. 227 pp.
- Rosene, W., Jr. 1955. Bicolor as a rabbit food. J. Wildl. Manage. 19(2):324.
- Smith, J. G. 1952. Food habits of mule deer in Utah. J. Wildl. Manage. 16(2):148-155.
- Smith, R. H. 1950. Cottontail rabbit investigations. New York State Conserv. Dep., Div. Fish and Game, Bur. Fish and Wildl. Investigations. Final Report P-R Proj. 1-R, Supplement B. 84 pp.
- Sparks, D. R. 1968. Diet of black-tailed jackrabbits on sandhill rangeland in Colorado. J. Range Manage. 21(4):203-208.
- Sweetman, H. L. 1944. Selection of woody plants as winter food by the cottontail rabbit. Ecology 25(4):467-472.
- Terrel, T. L. 1972. The swamp rabbit (Sylvilagus aquaticus) in Indiana. Am. Midl. Nat. 87(2):283-295.
- Tigner, J. R., and D. L. Gilbert. 1960. A contribution toward a bibliography on the black bear. Colorado Dep. Fish and Game Tech. Bull. 5. 42 pp.
- Toll, J. E., T. S. Baskett, and C. H. Conaway. 1960. Home range, reproduction, and foods of the swamp rabbit in Missouri. Am. Midl. Nat. 63(2):398-412.
- Turkowski, F. J. 1975. Dietary adaptability of the desert cottontail. J. Wildl. Manage. 39(4):748-756.
- Wetzel, J. F., J. R. Wambaugh, and J. M. Peek. 1975. Appraisal of white-tailed deer winter habitats in northeastern Minnesota. J. Wildl. Manage. 39(1):59-66.
- Wilson, K. A. 1976. Management of the muskrat in North Carolina. N. C. Wildl. Resour. Comm. Leaflet. Raleigh, N. C. 5 pp.
- Yeager, L. E. 1941. A contribution toward a bibliography on North American fur animals. Illinois Nat. Hist. Sur. Biol. Notes 16. 209 pp.

Miscellaneous

- Anderson, O. L. 1969. Making land produce useful wildlife. U. S. Dep. Agr. Farmers' Bull. 2035. 29 pp.
- Byrd, N. A., and H. L. Holbrook. 1974. How to improve forest game habitat. U. S. Dep. Agr. Forest Service Forest Management Bull. n.p.
- Godfrey, P. J., and M. M. Godfrey. 1976. Barrier island ecology of Cape Lookout National Seashore and vicinity, North Carolina. National Park Serv. Sci. Monogr. Series 9. 160 pp.
- Goodrum, P. D. 1959. Acorns in the diet of wildlife. Proc. Southeastern Assoc. Game and Fish Comm. 13:54-57.
- Goodrum, P. D., V. H. Reid, and C. E. Boyd. 1971. Acorn yields, characteristics, and management criteria of oaks for wildlife. J. Wildl. Manage. 35(3):520-532.
- Hervey, D. F. 1956. Cooperative experimental big game range revegetation: improving germination of browse seed. Colorado Div. of Wildl. W-072-R-04 Job 1. Job Completion Report. 4 pp.
- Hervey, D. F., and R. J. Boyd. 1953. Experimental big game revegetation: improving germination of browse seed. Colorado Div. of Wildl. W-072-R-01 Job 1A. Job Completion Report. 11 pp.
- Hutnik, R. J., and G. Davis. 1973. Ecology and reclamation of devastated land. 2 vols. Gordon and Breach Science Publ., New York. 1042 pp.
- McKibben, L., and R. Slayback. 1977. Establishing woody plants for upland game habitat in California. Wildl. Habitat Leaflet 6. California Dept. Fish and Game and U. S. Dep. Agr. Soil Conserv. Service. 7 pp.
- Moody, R. D., and J. O. Collins. 1953. Evaluation of wildlife management practices in Louisiana. Louisiana Wildl. and Fish. Comm. Annual Progress Report Proj. 24-R-3. 54 pp.
- Moore, J. L. 1970. Bibliography of wildlife theses. Biological Information Service, Los Angeles, Calif. 291 pp.
- Park, B. C. 1942. The yield and persistence of wildlife food plants. J. Wildl. Manage. 6:118-121.

- Potter, T. R. 1974. Upland Ecological Succession Biosis File. Bibliography No. 3713 0679. N. C. Science and Technology Research Center, Research Triangle Park, N. C.
- Roseberry, J. L. 1963. Evaluation of habitat development on spoil banks: re-establishment of fauna and flora on spoilbanks resulting from wheel and shovel excavators--a comparative analysis. Illinois Dept. Conserv. W-064-R-05 Job 1. Job Completion Report. 49 pp.
- U. S. Department of Interior, Bureau of Sport Fisheries and Wildlife. 1974. Bibliography of research publications of the U. S. Bureau of Sport Fisheries and Wildlife, 1928-72. U. S. Dep. of Interior, Bur. Sport Fish. and Wildl. Resour. Publ. 120. 154 pp.
- Wali, M. K. 1975. Practices and problems of land reclamation in western North America. University of North Dakota Press, Grand Forks, N. D. 196 pp.
- Woodhouse, C., and L. Partin. 1975. Tarheel wildlife on the farm. Game Div., North Carolina Wildl. Resour. Comm., Raleigh, N. C. 20 pp.
- Yocom, C., and V. Brown. 1971. Wildlife and plants of the Cascades. Naturegraph Co., Healdsburg, Calif. 286 pp.

APPENDIX A : 250 PLANTS WITH FOOD OR COVER VALUE FOR WILDLIFE LISTED BY STATE AND LIFE FORM.

Scientific name, common name	NORTHEAST										SOUTHEAST					NORTH CENTRAL					SOUTH CENTRAL					NORTHWEST					SOUTHWEST				
	CT	DE	NY	MA	VT	NH	RI	PA	OH	IN	VA	NC	SC	GA	FL	TX	OK	MO	IL	IA	MI	WI	ND	SD	NE	KS	WY	MT	OR	WA	AK				
TREES																																			
<i>Celtis laevigata</i> , Sugar hackberry			X									X	X	X	X																				
<i>Diospyros virginiana</i> , Persimmon	X	X	X	X				X	X	X	X	X	X	X	X																				
<i>Juniperus virginiana</i> , Eastern redcedar	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																				
<i>Morus rubra</i> , Red mulberry	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																				
<i>Persea borbonia</i> , Red bay		X		X																															
<i>Pinus contorta</i> , Shore pine																																			
<i>Pinus palustris</i> , Longleaf pine																																			
<i>Pinus taeda</i> , Loblolly pine		X		X																															
<i>Pinus elliotii</i> , Slash pine																																			
<i>Populus alba</i> , White poplar																																			
<i>Populus deltoides</i> , Eastern cottonwood	X		X	X	X	X	X	X	X	X	X	X	X	X	X																				
<i>Populus trichocarpa</i> , Black cottonwood																																			
<i>Quercus virginiana</i> , Live oak																																			
<i>Robinia pseudocacia</i> , Black locust		X	X	X	X	X	X	X	X	X	X	X	X	X	X																				
<i>Salix nigra</i> , Black willow	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																				
SHRUBS																																			
<i>Alnus rubra</i> , Red alder																																			
<i>Alnus serrulata</i> , Tag alder		X	X	X	X	X	X	X	X	X																									
<i>Amelanchier canadensis</i> , Canadian serviceberry	X	X	X	X	X	X	X	X	X	X	X																								
<i>Amelanchier obovatis</i> , Coastal Juneberry		X	X	X	X	X	X	X	X																										
<i>Arctostaphylos uva-ursi</i> , Bearberry	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																				
<i>Atriplex breweri</i> , Brewer saltbush																																			
<i>Atriplex canescens</i> , Wingscale																																			
<i>Atriplex lentiformis</i> , Quail brush																																			
<i>Atriplex polycarpa</i> , Quail brush																																			
<i>Calli-carpa americana</i> , Beautyberry																																			

Scientific name, common name	NORTHEAST												SOUTHEAST					NORTH CENTRAL					SOUTH CENTRAL					NORTHWEST					SOUTHWEST					
	CT	DE	MD	ME	MA	MI	IN	OH	PA	RI	VA	AM	TX	FL	GA	NC	SC	AL	LA	TX	OK	MO	KS	NE	WY	MT	ND	SD	UT	CO	WY	MT	ND	SD	UT	CO	WY	
SHRUBS (cont'd)																																						
<i>Ceanothus thyrsiflorus</i> , Blue brush																																						
<i>Cornus amomum</i> , Silky dogwood	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>Cornus drummondii</i> , Rough-leaved dogwood																																						
<i>Cornus florida</i> , Florida dogwood	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>Cornus occidentalis</i> , Western dogwood																																						
<i>Cornus racemosa</i> , Gray dogwood	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>Cornus stolonifera</i> , Redstem dogwood	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>Cytisus scoparius</i> , Scotch broom																																						
<i>Elaeagnus angustifolius</i> , Russian olive	*																																					
<i>Elaeagnus pungens</i> , Thorny elaeagnus	*																																					
<i>Elaeagnus umbellata</i> , Autumn olive	*																																					
<i>Gaultheria shallon</i> , Salal																																						
<i>Ilex decidua</i> , Possumhaw																																						
<i>Ilex glabra</i> , Galberry	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
<i>Ilex verticillata</i> , Winterberry	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
<i>Ilex vomitoria</i> , Yaupon	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
<i>Lespedeza bicolor</i> , Bicolor lespedeza	*																																					
<i>Lespedeza japonica</i> , <i>Lespedeza japonica</i> (VA70)																																						
<i>Lonicera maackii</i> , Amur honeysuckle	*																																					
<i>Lonicera tatarica</i> , Tartarian honeysuckle	*																																					
<i>Lupinus albus</i> , Bush lupine																																						
<i>Lupinus chamissonis</i> , Bush lupine																																						
<i>Myrica californica</i> , Pacific wax myrtle																																						
<i>Myrica cerifera</i> , Wax myrtle	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
<i>Myrica pennsylvanica</i> , Bayberry	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
<i>Prosopis juliflora</i> , Honey mesquite																																						
<i>Prunus angustifolia</i> , Chickasaw plum																																						
<i>Prunus caroliniana</i> , Carolina laurelcherry																																						

*Ornamental or agricultural cultivar

Scientific name, common name SHRUBS (cont'd)	NORTHEAST					SOUTHEAST					NORTH CENTRAL					SOUTH CENTRAL					NORTH- WEST					SOUTH- WEST																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
	CT	DE	NY	PA	VA	AL	FL	GA	NC	SC	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY	MO	IL	IN	MI	OH	PA	VA	NC	SC	GA	FL	AL	MS	LA	TX	OK	AR	KY

*Ornamental or agricultural cultivar

Scientific name, common name	CT	DE	IN	ME	MD	MA	MI	MN	NH	NJ	NY	OH	PA	RI	VT	VA	WV
SHRUBS (cont'd)																	
Salix lasiandra, Pacific willow																	
Salix parksiana,																	
Salix purpurea, Purple osier	*																
Salix sericea, Silky willow	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Sambucus caerulea, Blue elderberry																	
Sambucus callicarpa, Elderberry																	
Sambucus canadensis, American elderberry	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Sambucus racemosa, Elderberry																	
Shepherdia canadensis, Russet buffaloberry				X			X							X			
Vaccinium arboreum, Sparkleberry				X					X							X	X
Vaccinium corymbosum, Highbush blueberry	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Vaccinium ovatum, Western huckleberry																	
Vaccinium stamineum, Squaw huckleberry	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
VINES																	
Ampelopsis arborea, Pepper-vine					X											X	
Celastrus scandens, American bittersweet	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Lonicera japonica, Japanese honeysuckle	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X
Parthenocissus quinquefolia, Virginia creeper	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Smilax auriculata, Wild bamboo																	
Smilax bona-nox, Fringed cathrier		X														X	
Smilax glauca, Sawbrier	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Smilax laurifolia, Bamboo-vine		X		X	X		X		X							X	
Smilax rotundifolia, Common greenbrier	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Vitis aestivalis, Summer grape	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Vitis labrusca, Fox grape	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Vitis vinifera, Riverbank grape	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

*Ornamental or agricultural cultivar

[illegible]

Scientific name, common name	NORTHEAST										SOUTHEAST					NORTH CENTRAL					SOUTH CENTRAL					NORTHWEST					SOUTHWEST																			
	CT	DE	IN	ME	MA	MI	NH	NJ	NY	OH	PA	RI	VT	WA	AT	FL	GA	KY	NC	SC	TN	IL	IA	MO	ND	SD	WI	AR	LA	MS	AL	TX	OK	TX	ID	MT	OR	WA	WY	AZ	CA	CO	NV	UT						
HERBS (cont'd)																																																		
<i>Cyperus schweinitzii</i>	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
<i>Descurainia pinnata</i> var. <i>pinnata</i> , Tansey mustard																X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
<i>Eleocharis palustris</i> , Common spikerush	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>Eleocharis parvula</i> , Dwarf spikerush	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>Eleocharis quadrangulata</i> , Squarestem spike-rush	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>Erodium botrys</i> , Big filaree																X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>Erodium cicutarium</i> , Common filaree	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>Erodium moschatum</i> , Musk filaree																X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>Erodium obtusipicatum</i> , Filaree																X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>Euphorbia corollata</i> , Flowering spurge	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>Euphorbia esula</i> , Spotted spurge	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>Euphorbia maculata</i> , Spotted spurge	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>Euphorbia supina</i> , Prostrate spurge	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>Fragaria chiloensis</i> , Beach strawberry																X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>Fragaria virginiana</i> , Wild strawberry																X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>Glycine ussuriensis</i> , Reseeding soybean *																X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>Helianthus maximiliani</i> , Maximilian's sunflower																X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>Helianthus tuberosus</i> , Jerusalem artichoke	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>Lathyrus japonicus</i> var. <i>glaber</i> , Beach pea	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>Lathyrus palustris</i> , Marsh pea	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>Lathyrus sylvestris</i> , Flat pea *																X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>Lespedeza cuneata</i> , Sericea lespedeza *																X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>Lespedeza stipulacea</i> , Korean clover *																X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>Lespedeza striata</i> , Japanese clover *																X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

*Ornamental or agricultural cultivar

Scientific name, common name	NORTHEAST										SOUTHEAST					NORTH CENTRAL					SOUTH CENTRAL					NORTHWEST					SOUTHWEST																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
	CT	DE	IL	IN	MI	MO	NE	ND	PA	RI	VA	WV	AM	AL	GA	NC	SC	NL	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX	OK	MO	KS	LA	AR	TX

*Ornamental or agricultural cultivar

Scientific name, common name	CT	DE	IN	ME	MA	MI	NH	NJ	NY	PA	RI	VT	VA	WA
GRASSES (cont'd)														
<i>Cynodon dactylon</i> , Bermuda grass	X													
<i>Digitaria ischaemum</i> , Smooth crabgrass	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>Digitaria sanguinalis</i> , Large crabgrass	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>Echinochloa colonum</i> , Jungle-rice														
<i>Echinochloa crusgalli</i> , Barnyard grass	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>Echinochloa crusgalli</i> var. <i>frumentacea</i> , Japanese millet	*													
<i>Echinochloa walteri</i> , Walter's millet	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>Eleusine indica</i> , Goose grass	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>Elymus mollis</i> , American dune-grass	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>Festuca arundinacea</i> , Tall fescue	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>Festuca octoflora</i> , Sixweeks fescue	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>Festuca rubra</i> , Red fescue	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>Hordeum vulgare</i> , Barley	*													
<i>Leersia oryzoides</i> , Rice cutgrass	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>Lolium multiflorum</i> , Italian ryegrass	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>Lolium perenne</i> , Perennial ryegrass	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>Panicum amarulum</i> , Shoredune panicum	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>Panicum anceps</i> , Beaked panicum	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>Panicum clandestinum</i> , Deertongue	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>Panicum dichotomiflorum</i> , Fall panicum	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>Panicum lanuginosum</i> , Woolly panicum	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>Panicum miliaceum</i> , Proso millet	*													
<i>Panicum ramosum</i> , Browntop millet	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>Panicum texanum</i> , Texas millet														
<i>Panicum virgatum</i> , Switchgrass	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<i>Paspalum boscianum</i> , Bull paspalum														
<i>Paspalum notatum</i> , Bahia grass	*													

*Ornamental or agricultural cultivar

Scientific name, common name	NORTHEAST												SOUTHEAST					NORTH CENTRAL					SOUTH CENTRAL					NORTH-WEST					SOUTH-WEST				
	CT	DE	IN	ME	MD	MA	MH	MI	NE	NY	OH	PA	RI	VA	WA	AT	FL	GA	KY	NC	TX	AR	LA	MO	OK	TX	ID	MT	OR	WA	WY	AZ	CA	CO	UT	WV	
GRASSES (cont'd)																																					
<i>Paspalum vaginatum</i> , Seashore paspalum																																					
<i>Pennisetum glaucum</i> , Pearl millet																																					
<i>Phalaris arundinacea</i> , Reed canary grass																																					
<i>Phragmites communis</i> , Common reed																																					
<i>Phleum pratense</i> , Timothy																																					
<i>Poa macrantha</i> , Seashore bluegrass																																					
<i>Secale cereale</i> , Rye																																					
<i>Setaria italica</i> , Foxtail millet																																					
<i>Setaria lutescens</i> , Yellow bristlegrass																																					
<i>Setaria viridis</i> , Green bristlegrass																																					
<i>Sorghum vulgare</i> , Sorghum (milo)																																					
<i>Spartina patens</i> , Saltmeadow cordgrass																																					
<i>Sporobolus cryptandrus</i> , Sand dropseed																																					
<i>Sporobolus poiretii</i> , Smutgrass																																					
<i>Sporobolus virginicus</i> , Virginia dropseed																																					
<i>Triticum aestivum</i> , Wheat																																					
<i>Zea mays</i> , Corn																																					

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APPENDIX B: RARE, ENDANGERED, OR THREATENED SPECIES REFERENCES

The following references are presented as listed in a draft report Management of Transmission Line Rights of Way for Fish and Wildlife for Evaluation Purposes prepared for the USFWS by Asplundh Environmental Services (1977).

Priority Wildlife Species References

- Alabama Museum of Natural History, and Alabama Department of Conservation and Natural Resources. 1976. Endangered and threatened plants and animals of Alabama. AL Museum Nat. History Bull. 2. 93 pp.
- Arizona Game and Fish Department. 1976. Threatened wildlife in Arizona. Phoenix. 8 pp. (Manuscript.)
- Buechner, H. K., and D. B. Marshall. 1974. Threatened ungulates of North America. Pages 138-157 in Proceedings of the symposium on endangered and threatened species of North America. The Wild Canid Survival and Research Center, St. Louis, MO.
- California Department of Fish and Game. 1976. At the crossroads - a report on California's endangered and rare fish and wildlife. Sacramento. 101 pp.
- Colorado Wildlife Commission. 1976. Regulations on protected animals. Denver. 6 pp.
- Connecticut Department of Environmental Protection. 1976. Threatened and endangered wildlife. Hartford. 11 pp. (Typewritten.)
- Cox, James. 1975. The endangered ones. Crowell Publications, Inc.
- Endangered-threatened species list for West Virginia. (Miscellaneous manuscripts.)
- Florida Committee on Rare and Endangered Plants and Animals. 1974. Provisional lists of rare and endangered plants and animals of Florida. 17 pp. (Draft; manuscript.)

- Georgia Department of Natural Resources, Game and Fish Division. 1976. Protection of endangered, threatened, rare, or unusual species. Rules Chapter 391-4-13. Pages 1231-1240. Atlanta.
- Illinois Department of Conservation, Nature Preserves Commission. 1976. Endangered, vulnerable and rare vertebrates of Illinois; interim list of species. Springfield. 7 pp.
- Indiana Department of Natural Resources, Division of Fish and Wildlife. 1975. Non-game and endangered species conservation - a preliminary report. Indianapolis. 5 pp.
- Iowa Conservation Commission. 1977. Proposed endangered species lists. Des Moines. (4 manuscripts.)
- Kansas Forestry, Fish and Game Commission. 1977. Non-game, threatened, or endangered species. Pratt. 3 pp. (Proposed regulation.)
- Kentucky Department of Fish and Wildlife Resources. n.d. Kentucky's rare and endangered species. Frankfort. 16 pp. (Manuscript.)
- Kentucky Department of Fish and Wildlife Resources. 1973. Protection of rare and endangered fish and wildlife species. KFWR-H&F-7. Frankfort. 2 pp. (Draft.)
- Lahart, D. 1973. Florida's endangered dozen. Pages 15-20 in Florida Wildlife, February 1973.
- Louisiana Cooperative Wildlife Research Unit. 1977. Endangered or threatened species list of Louisiana. Baton Rouge. 1 p. (Unofficial list; manuscript.)
- Maryland Department of Natural Resources. 1972. Maryland endangered species list (Authority Title 10, Section 210 C); Wildlife Conservation Regulation 08.03.01. 1 p.
- Massachusetts Division of Fisheries and Game. 1973. List of rare and endangered animals of Massachusetts. Westboro (field headquarters). (Proposed list in memo form.)
- Michigan Department of Natural Resources. 1976. Michigan's endangered and threatened species program. Lansing. 30 pp.
- Minnesota Department of Natural Resources. 1975. The Uncommon Ones. St. Paul. 32 pp.
- Mississippi Game and Fish Commission. 1975. An order and regulations adopting an official list of endangered and threatened vertebrates in Mississippi. Jackson. 2 pp.

- Mississippi Rare and Endangered Species Committee. 1975. A preliminary list of rare and threatened vertebrates in Mississippi. Jackson. 29 pp.
- Missouri Department of Conservation and U. S. Soil Conservation Service. 1974. Rare and endangered species of Missouri. Jefferson City.
- Montana Department of Fish and Game, Environment and Information Division. 1974. A proposed list of endangered species of Montana wildlife. Helena. 2 pp.
- Nebraska Game and Parks Commission, Wildlife Division. 1976. Nebraska's endangered and threatened wildlife species lists and regulations. Lincoln. 5 pp. (Manuscript.)
- New Hampshire Fish and Game Department. 1977. List of New Hampshire wildlife found on federal endangered list. Concord.
- New Jersey Department of Environmental Protection. 1975. Endangered, threatened, peripheral, and undetermined wildlife species in New Jersey (official list). NJ State Register, April 10, 1975. 10 pp.
- New Mexico State Game Commission. 1975. Protection of endangered species and subspecies of New Mexico. State Game Comm. Reg. 563. 4 pp.
- New York Department of Environmental Conservation. 1977. Order amending traffic in endangered species of fish and wildlife. Albany.
- New York State Department of Environmental Conservation, Wildlife Resources Center. 1977. New York State wildlife: protected and unprotected species. Delmar. 6 pp. (Draft report.)
- North Carolina Department of Natural and Economic Resources, Endangered Species Committee. 1973. Preliminary list of endangered plant and animal species in North Carolina. Raleigh. 25 pp.
- Ohio Department of Natural Resources. 1976. Endangered wild animals in Ohio. Publication 316(R576). Columbus. 3 pp. (Official list.)
- Oregon Wildlife Commission. 1975. Threatened or endangered Oregon wildlife. Portland. 13 pp. (Manuscript.)
- Pennsylvania Fish Commission, Office of Information. 1975. Pennsylvania's endangered fish, reptiles, and amphibians. Harrisburg. 1 p. (Manuscript.)
- Preble, D. E. n.d. Threatened and endangered species in Rhode Island. RI Division of Fish and Wildlife, Providence. 1 p. (Manuscript.)

- Rare and Endangered Species of Oklahoma Committee. 1975. Rare and endangered vertebrates and plants of Oklahoma. 44 pp.
- South Carolina Wildlife and Marine Resources Department. 1975. Amendment to Section 28-729 and 28-731, 1962 South Carolina Code of Laws (concerning endangered species). Columbia.
- Texas Parks and Wildlife Department. 1976. Regulations for taking, possessing, transporting, exporting, processing, selling, or offering for sale, or shipping endangered species. Regulation 127.30. 09.001-006. Austin. 3 pp.
- U. S. Department of Interior, Fish and Wildlife Service. 1976. Endangered and threatened wildlife and plants. Federal Environment Memorandum ND-3. Bismarck. 8 pp.
- United States Department of the Interior, Fish and Wildlife Service. 1976. Endangered and threatened wildlife and plants. Federal Register 41(208):47181-47198.
- U. S. Fish and Wildlife Service. 1977. Endangered and threatened species list for Washington State as found in the October 27, 1976, Federal Register. Olympia, WA (Ecological Services Office). 1 p. (Typewritten.)
- Vermont Fish and Game Department. 1975. Endangered species list for the state of Vermont. Section 3651(3)(A) and Section 3651(3)(B) of Title 13, Vermont Statutes Annotated.
- Virginia Cooperative Wildlife Research Unit. n.d. Endangered and rare vertebrates of Virginia. Blacksburg. 5 pp. (Manuscript.)
- Wisconsin Department of Natural Resources. 1975. Endangered animals in Wisconsin. Madison. 10 pp.
- Two additional references are available.
- Arkansas Department of Planning. 1974. Arkansas Natural Area Plan. Prepared by Arkansas Department of Planning, Little Rock. 248 pp.
- Odom, R. R., J. L. McCollum, M. A. Neville, and D. R. Wttman. 1977. Georgia's protected wildlife. Prepared by Endangered Species Program, Georgia Department of Natural Resources, Atlanta. 51 pp.

APPENDIX C: ADDRESSES FOR SOIL CONSERVATION SERVICE
PLANT MATERIALS SPECIALISTS, PLANT MATERIALS
CENTERS, AND REGIONAL BIOLOGISTS

Chief Plant Materials Specialist

Soil Conservation Service
Washington, D. C. 20250
FTS 447-5667

Regional Plant Materials Specialists

Northeast

1974 Sproul Road
Broomall, Pennsylvania 19008
FTS 596-5827

Midwest

USDA-SCS
Federal Building
U.S. Courthouse, Rm. 345
Lincoln, Nebraska 68508
FTS 867-5349

South

P. O. Box 6567
Fort Worth, Texas 76115
FTS 334-5408

West

Room 510
511 N. W. Broadway
Portland, Oregon 97209
FTS 423-2841

Field Plant Materials Specialists

Arizona

Federal Building
231 N. 1st Avenue
Phoenix, Arizona 85025
FTS 261-6036 ext. 43
COMM (602) 261-6711 ext. 43

Colorado

Box 17107
Denver, Colorado 80217
FTS 327-3167
COMM (303) 837-3167

Georgia

P. O. Box 832
Athens, Georgia 30601
FTS 289-2115

California

P. O. Box 368
Lockeford, California 95237
FTS 556-9000 ask for 727-5319

Florida

P. O. Box 1208
Gainesville, Florida 32602
FTS 946-3871 ext. 136

Hawaii

Box 74
Hoolehua, Hawaii 96729
FTS 556-0220 ask for 567-6378

Idaho

304 North 8th Street, Rm. 345
Boise, Idaho 83702
FTS 554-1611
COMM (208) 342-2711 ext. 2609

Michigan

1405 South Harrison Road
East Lansing, Michigan 48823
FTS 374-4252
COMM (517) 372-1910 ext. 4252

Mississippi

P. O. Box 610
Jackson, Mississippi 39205
FTS 490-4335 or 4336

New Jersey

1370 Hamilton Street
P. O. Box 219
Somerset, New Jersey 08873
FTS 342-5243
COMM (201) 246-1206

North Carolina

P. O. Box 27307
Raleigh, North Carolina 27811
FTS 672-4318

Puerto Rico

Federal Experiment Station
P. O. Box 1000
Mayaguez, Puerto Rico 00708
COMM (809) 832-4202

Washington

Johnson Hall, Rm. 257
Washington State University
Pullman, Washington 99163
FTS 439-0111 ask for 332-2024

Kentucky

333 Waller Avenue
Lexington, Kentucky 40504
FTS 355-2747

Missouri

Parkade Plaza Shopping Center
P. O. Box 459
Columbia, Missouri 65201
FTS 276-3161
COMM (314) 442-2271 ext. 3161

Montana

P. O. Box 970
Bozeman, Montana 59715
FTS 585-4332
COMM (406) 587-5271 ext. 4332

New York

U.S. Courthouse and Federal
Building
100 S. Clinton Street, Rm. 771
Syracuse, New York 13202
FTS 951-3533
COMM (315) 473-3530 ext. 33

North Dakota

Federal Building
P. O. Box 1458
Bismarck, North Dakota 58501
FTS 783-4425
COMM (701) 255-4011 ext. 425

Texas

16-20 South Main Street
P. O. Box 648
Temple, Texas 76501
FTS 736-1291

West Virginia

293 University Avenue
Morgantown, West Virginia
16505
FTS 923-7151

Plant Materials Centers

National Plant Materials Center
Building 509, ARC
Beltsville, Maryland 20705
FTS 344-2175

Alaska

Alaska Plant Materials Center
Star Rt. B
Palmer, Alaska 95237
COMM (907) 745-4469

Arizona

Tucson Plant Materials Center
3241 Romero Road
Tucson, Arizona 85705
FTS 762-6491
COMM (602) 792-6491

California

Lockeford Plant Materials Center
P. O. Box 368
Lockeford, California 94566
COMM (209) 727-5319

Colorado

Environmental Plant Center
P. O. Box 448
Meeker, Colorado 81641
COMM (303) 878-5131

Florida

Brooksville Plant Materials Center
Route 2, Box 242
Brooksville, Florida 33512
COMM (904) 796-9600

Georgia

Americus Plant Materials Center
P. O. Box 688
Americus, Georgia 31709
COMM (912) 924-2286

Hawaii

Hawaii Plant Materials Center
P. O. Box 236
Hoolehua, Hawaii 96729
FTS 556-0220 ask for 567-6378

Idaho

Aberdeen Plant Materials Center
P. O. Box AA
Aberdeen, Idaho 83210
COMM (208) 397-4181

Kansas

Manhattan Plant Materials Center
Rt. 2, Box 314
Manhattan, Kansas 66502
COMM (913) 539-8761

Kentucky

Quicksand Plant Materials Center
Quicksand, Kentucky 41363
COMM (606) 666-5069

Michigan

Rose Lake Plant Materials Center
Route 1
East Lansing, Michigan 48823
COMM (517) 641-6300

Mississippi

Coffeeville Plant Materials
Center
Coffeeville, Mississippi 38922
COMM (601) 675-2588

Missouri

Elsberry Plant Materials Center
P. O. Box 108
Elsberry, Missouri 63343
COMM (314) 898-2012

New Jersey

Cape May Plant Materials Center
Route 1, Box 236A
Cape May Courthouse, New Jersey 08210
COMM (609) 465-5901

New York

Big Flats Plant Materials Center
P. O. Box 295, Rt. 352
Big Flats, New York 14814
FTS 882-5050
COMM (607) 562-8691

Oregon

Corvallis Plant Materials Center
3240 NE Granger Avenue
Corvallis, Oregon 97330
FTS 420-4812
COMM (503) 757-4812

Washington

Pullman Plant Materials Center
Room 257, Johnson Hall
Washington State University
Pullman, Washington 99163
COMM (509) 332-2024

Montana

Bridger Plant Materials Center
Route 1, Box 81
Bridger, Montana 59014
COMM (406) 662-3579

New Mexico

Los Lunas Plant Materials Center
1036 Miller Street S.W.
Los Lunas, New Mexico 87031
COMM (505) 865-7340

North Dakota

Bismarck Plant Materials Center
Lincoln-Oakes Nursery
P. O. Box 1458
Bismarck, North Dakota 58501
FTS 783-4425
COMM (701) 255-4011 ext. 425

Texas

Route 1, Box 155
Knox City, Texas 79529
COMM (817) 658-3922

Regional Biologists

Northeast

Northeast Technical Service Center,
SCS
1974 Sproul Road
Broomall, Pennsylvania 19008

South

South Technical Service Center,
SCS
P. O. Box 6567
Fort Worth, Texas 76115

Midwest

Midwest Technical Service Center, SCS
Federal Building
U. S. Courthouse, Room 393
100 Centennial Mall North
Lincoln, Nebraska 68508

West

West Technical Service Center, SCS
511 N. W. Broadway
Portland, Oregon 97209

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Ocean Data Systems, Inc. Coastal Zone Resources Division.

Handbook for terrestrial wildlife habitat development on dredged material / by Coastal Zone Resources Division, Ocean Data Systems, Inc., Wilmington, N. C. Vicksburg, Miss. : U. S. Waterways Experiment Station ; Springfield, Va. : available from National Technical Information Service, 1978.

369, c19 p. : ill. ; 27 cm. (Technical report - U. S. Army Engineer Waterways Experiment Station ; D-78-37)

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4. Terrestrial habitats. 5. Wildlife. 6. Wildlife habitats.
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